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Meetings

American Chemical Society—August 19, 20, 21, 22, 23, and 24, San Francisco, California.

•

California Natural Gasoline Association—September 5, Richfield Building, Los Angeles.

•

American Institute of Mining and Metallurgical Engineers, Petroleum Division of Mid-Continent Section—October 10, 11, and 12, Houston, Texas.

•

American Gas Association, Manufacturers' Division—October 14, 15, 16, 17, and 18, Atlantic City, New Jersey.

•

American Association of Petroleum Geologists, Mid-Year Meeting—October 16 and 17, Mexico City, Mexico.

•

American Association of Petroleum Geologists, San Antonio Section (San Antonio Geological Society, Seventh Annual Meeting)—October 16 and 17, Mexico City, Mexico.

•

Independent Petroleum Association of America, Annual Meeting—November 4 and 5, Adolphus and Baker Hotels, Dallas, Texas.

•

American Petroleum Institute, Sixteenth Annual Meeting—November 11, 12, 13, and 14, Biltmore Hotel, Los Angeles, California.

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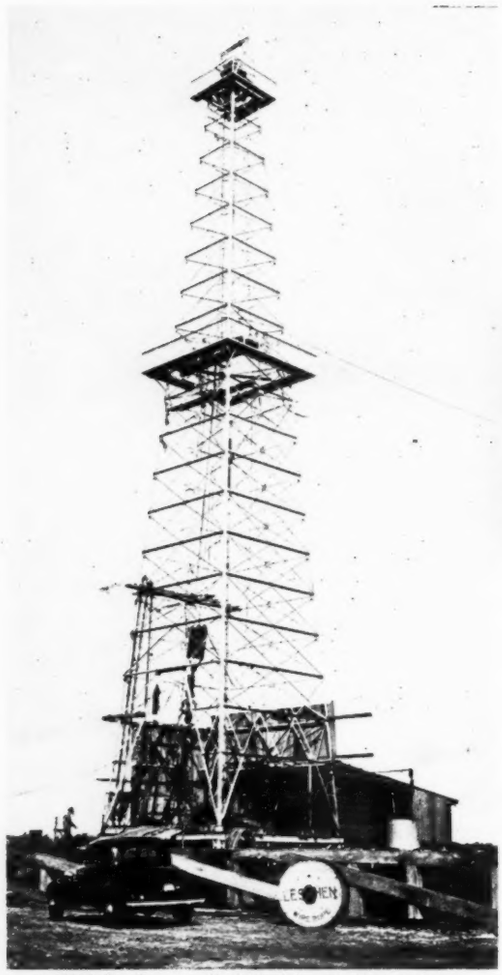

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The Course of Oil

By K. C. SCLATER

Exploring Water-Drive Possibilities

Water flooding, which for many years has been practiced so successfully as a secondary method of oil recovery in the Bradford field, Pennsylvania, has always held the curiosity of many operators regarding its application to other oilfields.

As an expulsive agent in forcing oil from sands depleted of gas energy, water under pressure is very much more effective than compressed air or natural gas, but greater risks attend its use. Air or natural gas can be injected into such oil sands and no serious harm done even if the results are not successful, but the injection of water is a different matter. Flooding an oil sand with water under pressure where the conditions are not favorable may do irreparable damage. This quite obvious risk has been an obstacle to a more extended adoption of water flooding in areas outside of the Bradford field. The average oil operator is reluctant to apply water-flooding methods, for he is inherently afraid of using water in this manner.

Only a thorough investigation of all subsurface factors having a bearing on the water drive, backed by sound experience in water-flooding operations, will reduce the attendant risks involved. A technique developed through years of experience is essential for reliable results and the successful application of water flooding to areas where it has not been tried before. In this connection the entry of the Forest Oil Corporation into the Mid-Continent field for the purpose of investigating the possibilities of water flooding in certain fields is significant. This company, one of the leading and most progressive operators in the Bradford field has been a pioneer in developing water-drive recovery methods and has a wealth of experience on which to draw and a capable trained personnel with which to carry on water-flooding operations. The area selected by this company for its first project is Northeastern Oklahoma. Water flooding was first tried out in this area about four years ago, but due to numerous causes and delays the work has been carried on in a rather desultory fashion. It appears now that water flooding will be given a thorough trial and the very latest practices and knowledge employed. Such a project backed by the experience, resources, and personnel of a company successful in pioneering and developing water-flooding practices in the Bradford field will be followed with interest. The results obtained may yield information that will be indicative of the possibilities of water-flooding methods in any field where the subsurface conditions are favorable.

Rodessa Field Regulation

Should the newly discovered deep oil-producing horizon in the Rodessa field, Louisiana, be very widespread, the field may extend into the states of Arkansas and Texas. In that event, the question of field regulation will involve three states. Interest, therefore, attaches to the recent announcement by Louisiana state authorities that the allowable production of wells in the Rodessa field will be based on acreage and potential, 75 percent and 25 percent respectively. Acreage allowance will be limited to a maximum of 40 acres and a minimum of five acres per well. No well will have its allowable increased above that of a 40-acre well or reduced below the 5-acre per well allowable. There will be no limitation on the well spacing. Determination of allowables will be made with the well flowing through a half-inch choke.

In promulgating this order it has been explained that the purpose of determining allowables thus is to protect owners of wells on small tracts and to prevent operators holding large acreage from overproducing individual wells.

Assuming that the field becomes a tri-state one it will be necessary for the states to agree among themselves on regulations for the field as a whole, in order to avoid any conflict. Thus it is that the regulations now announced by the state officials of Louisiana assume added importance.

Should the field extend into Texas the inclusion of acreage in determining allowables is one item that in itself may be the cause of much discontent and disagreement, particularly if it be applied to that part of the Rodessa field lying in Texas.

It will be the first time on record that a field whose production is curtailed and development controlled by state statute will be subject to the regulations of more than one state. It is well for those concerned to keep this possibility in mind with regard to the Rodessa field.

Defining a Gas Well

Defining a gas well, in contradistinction to an oil well, was necessary in Texas recently when restraining orders of the State Railroad Commission were attacked on the assumption by the Commission that certain wells in question were gas wells. The court inclined to adhere to the definition that a well that produced 100,000 cu. ft. of gas per barrel of liquid hydrocarbons, which in this case was gasoline, was a gas well and not an oil well. Such a well was construed by the complainants as an oil well and not a gas well.

Fine discrimination in definitions seems sometimes to be necessary regarding the production of a well.

In the case in question, the company was stripping gasoline from casinghead gas and releasing the residue gas to the atmosphere, neglecting to divert it to a source of utilization.

Release of gas to the atmosphere in large volumes is plainly a circumvention of state statutes, and cannot be justified on any grounds, technical or legal.

« « « HIGHLIGHTS IN OILDOM » » »

Exceptions to Well Spacing Rule to High Court

It will be left for the Supreme Court to decide the question of whether exceptions shall be made to Rule 37 governing well spacing in Texas. A motion for rehearing has been filed in the case of Brown vs. the Humble Oil and Refining Company, wherein the court condemned as invalid all exceptions that cause undue drainage from adjoining tracts or cause waste. The question cannot be passed upon until in the fall, as that is when the Supreme Court next convenes.

Spacing distances between oil wells are fixed by Rule 37 at 660 ft. in East Texas, with a minimum distance of 330 ft. from the property line. Numerous exceptions have been granted to this rule until the commission was recently brought to an abrupt halt by the Brown case.

The major companies having large leases have opposed the granting of permits to drill wells on fragments of leases or small tracts. The court condemned this practice emphatically, intimating that acreage instead of well allowables should be the basis of proration.

The court's opinion pointed out that a well on a fraction of an acre is not legally entitled to produce as much oil as one on several acres; that it would be unjust drainage. It further stated that a mere declaration in the commission's order that the exception was granted "to prevent confiscation" is not legally sufficient and that it must be proven before being granted.

●

Venezuela Crude Output Shows Increase

Figures recently released reveal that Venezuela produced a total of 46,161,402 bbl. of crude oil the first four months of 1935, compared with 42,556,780 bbl. for the corresponding period of last year, or a gain of 3,604,622 barrels. It is estimated that if drilling continues as at present the country will produce 10,800,000 bbl. more than during 1934.

●

California's Slant-Drilling Bill Fails to Pass

California's slant-drilling bill for tidal oil development failed of passage when Governor Merriam permitted it to die by way of the pocket veto route. In withholding his signature from the bill Governor Merriam stated that two legislative committees have been appointed to study the situation involved. His statement, in part, follows:

"I believe it is better this highly controversial question be given study in order that it may be finally decided in a way to satisfy all of the people and bring a maximum of revenue to the state.

"More, I believe, is to be gained by waiting the decisions of these two committees than is to be lost from immediate revenue under this bill, for it is highly probable that increases may be recommended in royalties and the number of wells, and a new method for competitive bidding found."

Since the next session of the legislature will not be held for another two years, nothing further can be done toward slant drilling of tidelands until that time, unless a special session is called.

New O. C. Wells East of Fault Producing From Wilcox

Confusion over certain producing horizons in the Oklahoma City field has been cleared up. New wells east of the fault in the north and east portion of the Oklahoma City field are producing from the Wilcox sand, even though other Wilcox producers are far distant, Don Knowlton, production official of the Phillips Petroleum Company, and two other witnesses testified at a recent hearing before the Oklahoma Corporation Commission. The hearing was called at the request of the oil and gas conservation officer to determine how to classify these new wells for the next proration period.

●

Prorate Gas Production in Texas

Proration of gas production in Texas by the Railroad Commission became effective August 1st. Proration is being based upon a combination of potential and acreage in the Texas Panhandle, and upon a straight potential basis elsewhere. The law was enacted by the last Legislature in an effort to prevent the waste of a billion cu. ft. of gas daily from the Panhandle gas field. It defined sweet and sour gas and empowered the Railroad Commission to prorate production of sweet gas.

Before going into effect, however, it was necessary for the new law to meet successfully injunction proceedings brought against it in Federal court by the Henderson Company of Sanford, Texas. The company asked for a temporary restraining order until a three-judge Federal court could pass upon the constitutionality of the law. Federal Judge Robert J. McMilland at San Antonio refused to issue the injunction.

●

California Working on Proration Plan

California is making progress in its attempt at voluntary control of the state's crude oil production. A proration plan now being developed involves an agreement between producers on the one hand, and refiners and pipe line companies on the other. That portion of the program affecting producers is being submitted for signatures at the present time, 95 per cent of the operators of the state being required. The purchasers are still somewhat at variance because no provision has been made to assure the small refiners of an ample crude supply.

The Pacific Petroleum Association is the name of the organization that would have for its membership the refiners and pipe line companies of the state.

J. R. Pemberton, present umpire, also would be umpire under the new agreement. A part of his duties would be to determine the amount of crude required from California during each quarter, and prorate it among the various fields of the state.

●

Pennsylvania Crude Off Another 10 Cents

During July Pennsylvania crude suffered another ten cents per bbl. reduction in price. Since the beginning of the current year crude in that state has been advanced 30 cents and been reduced a total of 40 cents a bbl., resulting in a net reduction of ten cents. Latest quotations are as follows: Bradford, $1.95; Southwest, $1.67; Eureka, $1.62; Buckeye, $1.52; and Corning grade, $1.32.

PROGRESS OF MAJOR PIPE LINE WORK

THE Lone Star Gas Company, Dallas, Texas, has awarded contracts for the construction of a 109-mile line from the Cayuga and Long Lake fields of Anderson County to points near Dallas. The Oklahoma Contracting Company, Dallas, will lay the 67 miles from Irving, near Dallas, to a point between Kerens and Trinidad, while Ford, Bacon & Davis, Inc., New York and Dallas, was given the contract for the 42 miles from that point to the Cayuga and Long Lake fields. The line will be constructed of 20-in. pipe, will be a combination welded and coupled one, and will cost approximately $2,225,000. More detailed information concerning the project will be found on pages 33, 34, and 35 of this issue of *The Petroleum Engineer*.

●

Construction of the Valley Pipe Line Company's new 90-mile oil line from the Sam Fordyce field of southwestern Hidalgo County, Texas, to Port Isabel is under way. The S. S. Beatrice of the Bull Steamship Lines arrived at Port Isabel August 3 with a load of pipe and couplings. It is planned to have the line in operation soon after September 1st.

Laying of the line has started at Port Isabel and will progress to the Sam Fordyce field. T. Frank Murchison, of Dallas, president of the Valley Pipe Line Company, is supervising construction in Cameron County, and H. H. Hensley, of McAllen, general manager of the company, is overseeing the work in Hidalgo County. The Freddell Construction Company of Houston and Denver are the general contractors.

Storage tanks built by the Wyatt Metal and Boiler Works, Dallas, are being erected in the Sam Fordyce field. The same firm has contracts for construction of facilities at Port Isabel for the Port Isabel Terminal Company and the Valley Port Refining Company, in both of which Murchison, E. M. Closuit, and associates are interested with G. L. Rowsey, head of the Taylor Refining Company, Taylor, Texas.

The line, which will be 5½ in. in diameter, will be the first oil pipe line ever to be completely coupled. Dresser couplings are being used.

●

The Republic Pipe Line Company is starting work on a line to extend from the Plymouth field of Texas to Corpus Christi, a distance of approximately 20 miles. The line is expected to be completed and in operation by September 1st. A large amount of oil is in storage in the field now awaiting a pipe line outlet. The Plymouth Oil Company has most of the production in the field.

A pumping station is to be constructed. Equipment will consist of three centrifugal pumps driven by electric motors, one unit to be used as a standby. The capacity of the line will be 15,000-bbl. daily.

Two 80,000-bbl. steel storage tanks are being erected by The Texas Company at its terminal in Corpus Christi, and another tank of the same size may be constructed. The Texas Company's plant at Corpus Christi will be the terminus of the Republic's new line.

●

Rumors are current that the Continental Oil Company will lay a 6-in. pipe line between Valley Center in Northern Sedgwick County, Kansas, to Russell County, a distance of approximately 115 miles. With but one pipe line now serving the Russell area, that section has an accrued underage of approximately 200,000 barrels. It is said more than 6000 bbl. of oil daily has been pledged to the Continental in event they construct a line.

●

The Phillips Petroleum Company is constructing a gas line approximately 25 miles in length from the sour gas area in Moore County, Panhandle, Texas, to its carbon black plants at Sanford and Borger. The line is being constructed of 24-in. pipe.

●

Since the discovery of oil recently in Rodessa gas field of Caddo Parish, Louisiana, the Standard Oil Company of Louisiana has laid an 8-in., 8-mile pipe line that connects with the company's trunk line to Baton Rouge.

The United Gas Public Service Company has constructed a three-mile line from its absorption plant at Myrtis to the drilling area to supply dry gas for fuel.

●

Application has been made to the Wyoming Public Service Commission by the Continental Oil Company for a permit to construct an oil line from the Lance Creek field to Manville, a distance of 18 miles. It is planned to move the oil from Manville to the company's refineries at Glenrock and Denver via rail. Production of the Lance Creek field recently was swelled by the addition of several large wells. At present but one line services the area, a 6-in. line of the Illinois Pipe Line Company.

●

It is reported that officials of the U. S. S. R. plan to lay a pipe line from the Neftedag field in Turkmenia to Krasnovodsk on the Caspian Sea. The destination of the oil likely would be refineries up the Volga River from Krasnovodsk, and in Central Asia.

●

A 16-mile gas line is being laid by the Sylvania Corporation from Colegrove in Norwich Township to Halsey in Sergeant Township, Pennsylvania. This line is in McKean County. A 12-mile line is being laid from Trapping Rock, Potter County, Pennsylvania, to the booster station in the Proctor district, Allegany County, New York, of the Columbia Gas and Electric Company. Both are 8-in. lines.

LATEST ACTIVITIES IN THE OIL FIELDS

DISCOVERY of the ninth producing horizon in the Fitts pool of Pontotoc County, Oklahoma, has caused oil men to hail that field as one of the most prolific areas in the state since the Tonkawa boom. The new producing horizon, known as the Burgen sand, was found by the No. 3 Atkins of E. H. Moore and associates in the southeastern edge of the field at 4405-75 feet. On a test of the sand the well increased its flow from 187 bbl. an hour to 808 barrels.

●

The finding of oil in the Rodessa gas field of Caddo Parish, Louisiana, below the gas producing horizon, has started a boom in that area. The United Gas Public Service Company's No. 1 I. L. Young, drilled to a total depth of 6048 ft., made an initial flow of 100 bbl. of light oil per hour from the Oolitic lime of the Glen Rose age. Later 5-in. casing was cemented to 5959 ft. over 2½-in. tubing to shut off a gas leak and the well then flowed at the rate of 116 bbl. per hour through ½-in. choke. The latest report on the well before going to press revealed it making 6600 bbl. daily. Since the bringing in of the discovery well numerous other tests have started and leasing has been active in the area.

●

Jack Frazier's No. 2 Lynott Buffon in Liberty County has opened a new Texas Gulf Coast field. The well is producing from the Discorbis Yeguaensis sands from 7665-85 feet. On the initial flow it made 15 bbl. of fluid per hour, 40 per cent of which was oil. This later increased and the well was producing 650 bbl. of 36.8 gravity oil per day.

●

Completion of No. 8 Merritt by the Vesta Petroleum Company has extended the Mountain View field, Kern County, California. The new producer is three-fourths of a mile northeast of the nearest production. An initial production of 750 bbl. daily of 23.1 gravity oil was obtained. Drilled to a total depth of 5140 ft., the well was plugged back to 5065 feet.

The Texas Company's No. 1 Saunders has extended the Monument field of New Mexico three and one-quarter miles to the northeast. The rated flow of the well is 568 bbl. daily, together with approximately 500,000 cu. ft. of gas, following treatment with acid. The oil tests 31.8 gravity.

●

Several developments in Western Kansas have attracted attention to that area recently. Ten miles southwest of Hays in Ellis County the Stanolind Oil and Gas Company cored a well-saturated sand from 3620½ to 3624½ feet. Harper County seemed assured of its first oil when Kessler et al.'s No. 1 Wolfe had a showing of oil from 4000 to 4010 feet. A fourth producing horizon has been found in the Sullivan pool, four miles southwest of Russell, by the Gypsy Oil Company. No. 1 Atherton of McMorrow et al., two miles west of production in the Russell pool, filled with 1700 ft. of oil in nine hours after being drilled to a total depth of 3289 ft. in the Arbuckle Siliceous lime.

●

The finding of oil in Brown and Wheeler's No. 1 Kaufmann, a western Goliad County wildcat, is considered one of the most important strikes of the year in Southwest Texas. Producing from the Yegua sand at a total depth of 4543 ft., the well initially made 20 bbl. of oil per hour through ¼-in. choke.

●

In the old Wynona area of Osage County, Oklahoma, the Norbla Oil Company, J. A. Chevalier, and H. A. Simon have opened a new producing horizon with their No. 1 Osage that is considered important. Production is from the Hominy-Wilcox and at a total depth of 2580 ft. the well made 150 bbl. of oil in an hour. Production in the pool has been coming from several horizons from 1600 ft. to 2300 ft., but initial flow in the upper horizons has never amounted to more than 500 bbl. per day.

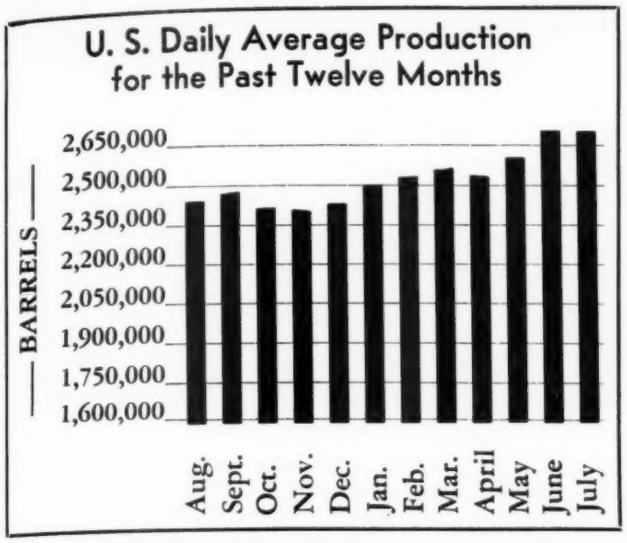
AVERAGE CRUDE OIL PRICES

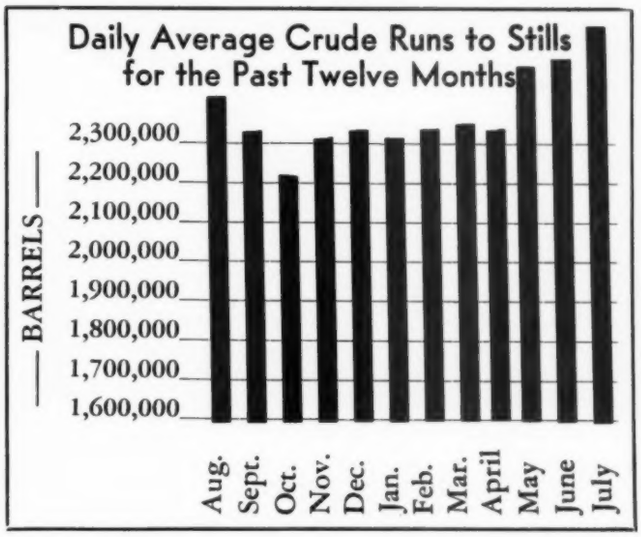
California		Louisiana	
Playa Del Rey	$ .90	North Louisiana	$ .95
Coalinga	.81	Gulf Coast	1.04
Signal Hill	1.12	Illinois	1.13
Montana	1.35	Kentucky	1.13
Wyoming	1.00	Indiana	1.12
Colorado	1.00	Ohio	
New Mexico	.75	Lima	1.30
Texas		Michigan	1.02
North Central	.95	Pennsylvania	
Panhandle	.51-.71	Bradford	1.95
West Texas	.70-.75	Southwest	1.67
Gulf Coast	1.04	Eureka	1.62
Darst Creek	.87	Buckeye	1.52
East Texas	1.00	Corning	1.32
Kansas	1.00	West Virginia	1.67
Oklahoma	1.00	Canada	2.10-2.17
Arkansas	.70		

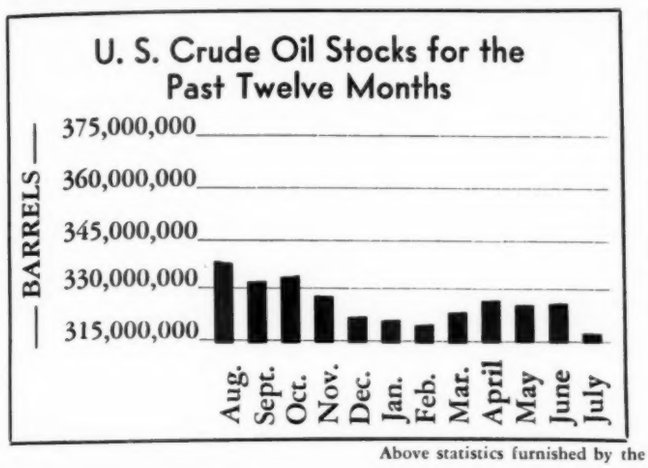
DAILY AVERAGE CRUDE OIL PRODUCTION
Furnished by A.P.I

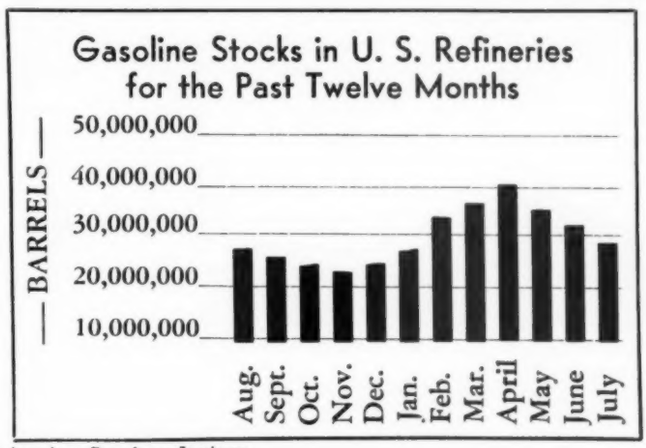
(Figures in Barrels)

	Dept. of Interior Calculations (July)	Week Ended July 27, 1935	Week Ended June 29, 1935	Week Ended July 28, 1934
Oklahoma	517,400	523,950	521,200	491,750
Kansas	155,600	153,050	147,500	136,750
Panhandle Texas		61,800	58,700	62,750
North Texas		59,050	59,250	58,700
West Central Texas		25,650	25,450	27,100
West Texas		156,750	153,900	147,900
East Central Texas		50,450	50,000	51,550
East Texas		465,000	466,900	468,650
Conroe		42,200	42,350	47,300
Southwest Texas		57,500	64,450	56,250
Coastal Texas (Not incl. Conroe)		146,600	143,900	123,100
TOTAL TEXAS	1,064,400	1,065,000	1,064,900	1,043,300
North Louisiana		22,650	22,650	24,550
Coastal Louisiana		113,900	118,550	73,600
TOTAL LOUISIANA		136,550	141,200	98,150
Arkansas		30,450	30,950	32,050
Eastern (Not incl. Michigan)		105,400	107,700	100,000
Michigan		45,000	42,950	30,100
Wyoming		42,400	38,400	37,250
Montana		11,150	10,100	8,900
Colorado		4,100	4,050	3,400
TOTAL RK. MT. ST.		57,650	52,550	49,550
New Mexico		54,000	52,900	47,400
California		563,600	528,000	518,300
TOTAL U. S.	2,660,000	2,734,650	2,689,850	2,547,350









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for July, 1935

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	421	408	164	259	3600	2	40	Rotary
Duval County	30	27	1	5	2300	2	22	Rotary
Archer County	80	54	15	46	660–1800	1 or 2	40	Rot.-Cab.
Conroe	10	8	2	5	2000–7400	3 or 4	40	Rotary
Panhandle	51	46	50	124	2200–3900	2	40	Rotary
Refugio County	4	4	1	6	5200	2	38	Rotary
OKLAHOMA								
Oklahoma City	10	10	6	42	6500	3	39	Rotary
Pontotoc County	28	22	16	67	1800–4488	2 or 3	38	Rotary
Osage County	22	17	18	43	380–2850	2	37 5–40	Rot.-Cab.
KANSAS								
McPherson County	8	6	3	20	2900–4300	2	38	Rot.-Cab.
Harvey County	4	1	1	10	3450	2 or 4	37	Rot.-Cab.
Ellsworth Arch	46	29	27	121	3300	4	37	Rot.-Cab.
CALIFORNIA								
Kettleman Hills	5	5	6	26	8300	3 or 4	40	Rotary
Long Beach	5	5	22	66	7000	3	36	Rotary

Field Activities by States for July, 1935

State	Completions July	Completions June	Producers July	Producers June	Locations July	Locations June	Rigs July	Rigs June	Drilling Wells July	Drilling Wells June	Production, 1934 (In Barrels)
Arkansas	4	8	1	2	9	1	10	9	31	26	11,412,100
California	82	55	72	49	102	86	112	92	275	270	175,678,362
Colorado	....	1	....	1	....	....	4	3	27	26	1,168,000
Illinois	1	3	1	2	....	....	12	14	13	12	4,466,000
Indiana	7	14	3	7	....	....	3	2	33	35	813,000
Kansas	107	92	65	65	77	138	30	50	210	229	45,577,050
Kentucky	19	6	16	5	....	....	4	4	26	24	4,863,000
Louisiana	67	61	45	34	85	89	54	62	146	164	32,572,900
Michigan	38	53	25	27	40	56	115	114	139	136	10,589,600
Mississippi	1	2	0	0	....	....	2	2	11	14	Gas Prod.
Montana	14	23	13	20	....	....	19	13	57	61	3,797,000
New Mexico	19	26	14	22	....	....	14	17	96	106	16,529,050
New York	....	....	....	....	....	....	1	1	3	2	3,880,700
Ohio	151	131	97	99	....	....	39	38	144	141	4,291,000
Oklahoma	190	177	119	120	215	262	77	76	501	546	176,506,550
Pennsylvania	4	8	3	5	....	....	28	40	143	103	15,353,850
Texas	990	986	775	752	1133	1567	513	630	1070	1491	380,848,000
West Virginia	31	43	22	34	....	....	33	21	83	74	4,043,550
Wyoming	6	10	4	8	....	....	15	13	71	64	12,371,100
Total	1731	1697	1275	1251	1661	2199	1085	1202	3079	3521	903,350,812

THE MONTH'S ACTIVITIES IN REFINING

Per Cent Refinery Capacity Operated

Eastern Division, 81.5 per cent **Central Division, 72.2 per cent** **Western Division, 69.5 per cent**

A REFINERY is to be constructed in Uruguay by A. N. C. A. P. (Administracion Nacional de Combustibles Alcohol y Portland) an agency of the Uruguayan government. The project, which had been under consideration for some time, has now been completely worked out by A. N. C. A. P. engineers in collaboration with the engineering staffs of Universal Oil Products Company and Foster Wheeler Company.

Senor Don Rodolfo P. Peracca, a well-known financier and business man of South America, has been active in negotiating between the various interests for the construction of the refinery, which will involve an investment of about $2,500,000.

The crude capacity of the refinery will be 3800 bbl. a day and the distillation equipment will consist of a pipe still unit that will produce gasoline, kerosene, gas oil, and fuel oil.

A Dubbs cracking unit of 1200-bbl. daily charging capacity will be installed. It will be of the full-flashing type, and will include stabilizing and absorption equipment and a clay-treating plant.

The refinery will be built at Montevideo, the capital of Uruguay.

●

Gasoline Products Company and Sun Oil Company announce that they have entered into a new license agreement pertaining to the cracking patents of the two companies. The Sun Oil Company was one of the first users of the Cross process under license from Gasoline Products Company, granted in 1922. Under the new agreement the Sun Oil Company has acquired from Gasoline Products Company a broad immunity and Gasoline Products Company has obtained the right to grant immunities under the cracking patents of Sun Oil Company.

No announcement was made regarding the Sun Oil Company patents or the monetary consideration, but it is understood that substantial cash payments are being made to Gasoline Products Company and that the Sun Oil Company has successfully developed and patented an important once-through type of process that will hereafter be available to the licensees of Gasoline Products Company.

W. S. Behrens, president of the Wolverine Petroleum Products Company, Alma, Michigan, announces his company has completed arrangements for the construction of a 1000-bbl. skimming plant.

Another refinery to be erected at Alma is that of the Borim Brothers of Detroit, Michigan. It will be a 2000-bbl. skimming plant and construction will get under way immediately.

●

The Gilliland Refining Company of Gladewater, Texas, is to erect a casinghead gasoline plant in Gregg County of the East Texas field. It will cost approximately $400,000 to construct. Gas from 100 wells already has been contracted for.

●

A 5000-bbl. per day capacity refinery may be constructed at Russell, Kansas. A group of operators in Russell and adjacent counties in the western part of the state are studying the proposition. One pipe line now reaches Russell County, but is unable to serve all the pools. Estimates indicate that the more than a dozen Russell County pools have a potential of 9305 bbl. a day, and back allowable due the operators is approximately 200,000 barrels.

●

A 1500-bbl. Dubbs cracking unit is to be built by the Solvex Refining Company at Gladewater, Texas. A license agreement has just been signed by Universal Oil Products Company and George Culver, president of the Solvex company.

The Dubbs unit will operate on the full-flashing system and will crack topped East Texas crude. This is the first Dubbs cracking unit to be built in the East Texas field. It is understood construction will be by the Frick-Reid Supply Corporation of Pittsburgh and Tulsa, and engineering by Burrell-Mase Engineering Company of Pittsburgh and Tulsa.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending July 27, 1935

A.P.I Figures

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Per Cent Operated of Total Capac ty Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	507,000	82.8	15,245	12,409
Appalachian	94.8	111,000	76.0	2,125	878
Ind., Ill., Ky.	95.9	363,000	85.6	9,036	5,109
Okla., Kans., Mo.	84.8	293,000	76.3	5,068	4,746
Inland Texas	48.5	95,000	59.4	1,132	1,834
Texas Gulf	96.4	588,000	98.8	4,883	10,943
La. Gulf	96.4	116,000	71.2	1,091	4,097
No. Louisiana-Ark.	90.0	40,000	55.6	258	399
Rocky Mountain	61.9	45,000	75.0	773	802
California	92.6	505,000	64.0	8,546	61,256
TOTALS WEEK:					
July 27, 1935	89.5	2,663,000	78.2	48,157	105,473
July 20, 1935	89.5	2,598,000	76.3	48,747	103,810

Drilling Activities in the Rodessa Field

Discovery of Deep Oil Sand Starts Drilling Campaign

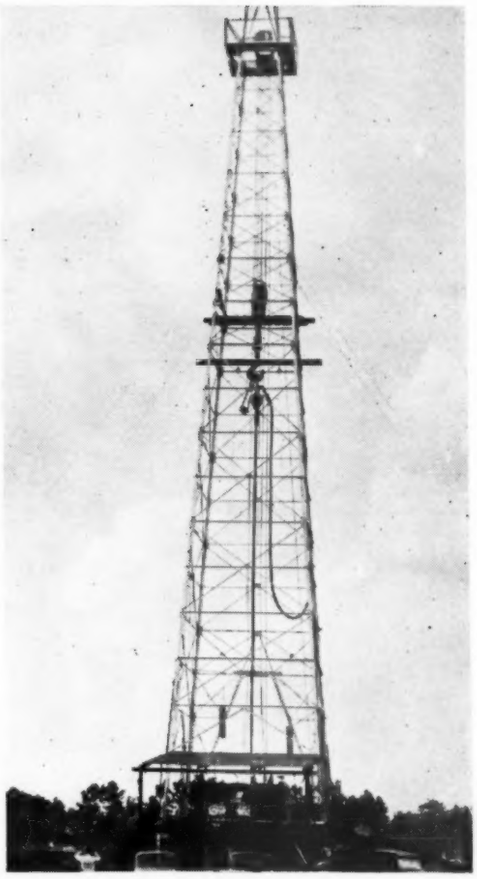
By FRANK H. LOVE

SINCE the United Gas Public Service Company's well I. Lee Young No. 1 discovered a deep oil sand in the Rodessa gas field of Caddo Parish, Louisiana, a deep-drilling campaign has been gaining momentum daily in that area. As this is written there are 11 drilling wells and nine locations, in addition to the one completed well. Leasing has been active and many veteran oil men are of the opinion that the field has bright prospects for extensive development. By virtue of having developed the gas area surrounding Rodessa, the United Gas Public Service Company had under contract a large acreage at the time oil was found. Subsequently many major companies, as well as independent operators, have leased the available acreage, some of them being as far distant as 35 miles from the discovery well and extending into Arkansas and Texas.

Several supply companies already have erected stores at Rodessa for servicing the field, and reports have it that 25 companies have leased warehouse space along the Kansas City Southern Railroad's right-of-way.

A definite program of drilling procedure is being followed by the operators active in the area, modern methods being employed to assure proper control of the hole and equipment at all times.

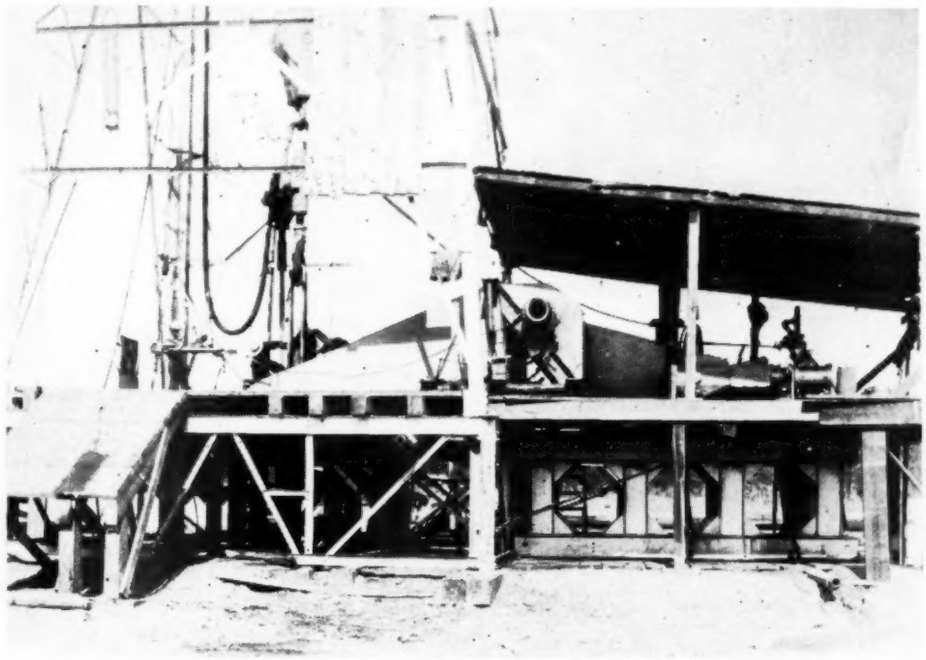
The discovery well was drilled in with a 6-in. drawworks, but most of those being used at present are 7-in. and 7½-in., and of two types, the regular and unitized. The engines, mounted on steel foundations, are 12x12, and the rotary table 26½ inches. Mud pumps show a slight variation in size, on some rigs being 14½x7¼x18, on others 14½x7½x18, while on still others they are 14x7x18. General practice calls for the use of three boilers to each drilling rig, from 85 hp. to 125 hp., the latter being operated on a working pressure of 250 pounds. All drilling rigs are using the readily available natural gas as fuel.



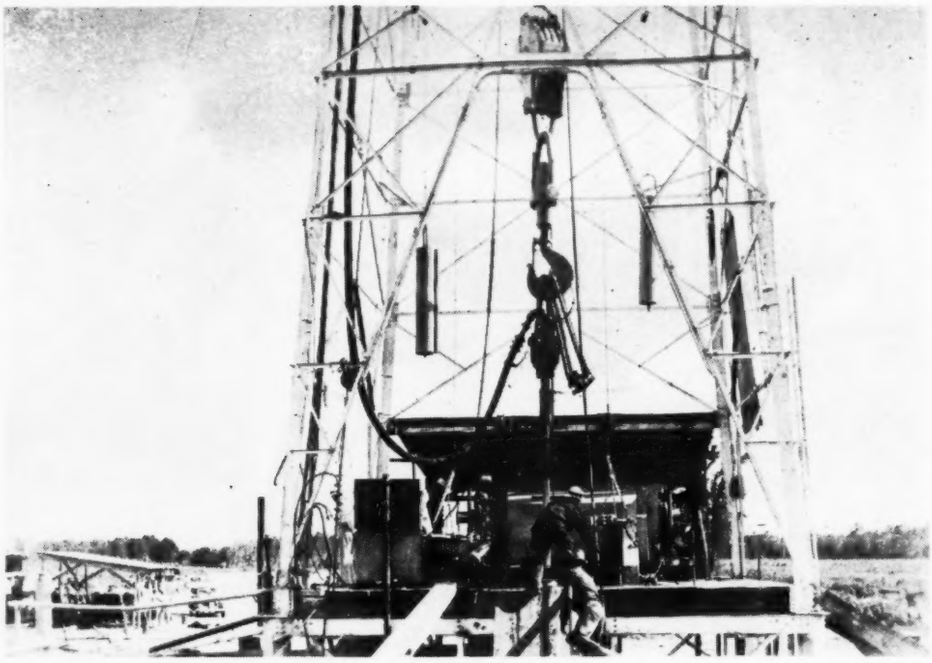
A 122-ft. steel derrick, with 24-ft. base is the type in general use at Rodessa

The steel derricks are 122 ft. in height, with a 24-ft. base. All substructures now are constructed of steel. This was not true in the case of the discovery well, which had wooden sills.

On the No. 1 Young well six lines were employed in drilling to a depth of 5600 ft., nine lines were used to set 7-in. casing at that depth, and for drilling-in the number was reduced to six. Some operators are now using seven lines and plan to employ the same number all the way down. A popular type of crown block is a straight line one of 900,000-lb. capacity, and the traveling block in general use the four-sheave, 56-in. type.



Side view of 7-in. drawworks, 12 x 12 roller-bearing engine. Note also the steel substructure



Haynes Production Company's No. 1 Otwell, one of the latest to spud in

of the mud, maintained from 20 to 35, depending upon the formation being drilled. The mud was circulated from slush pits, usually numbering two, with, in some instances, one reserve pit. The size of the pits are not uniform, some measuring 22 ft. by 100 ft. by 6 ft., while others are 12 ft. by 60 ft. by 6 ft. The reserve pits frequently cover as much as a quarter acre of ground.

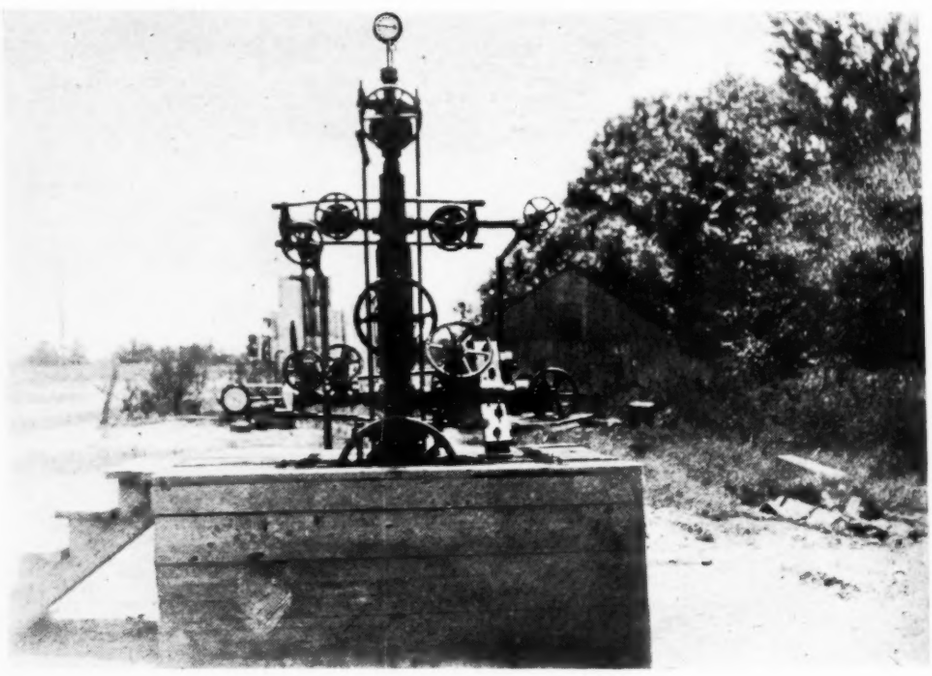
At least two of the rigs now drilling are equipped with mud screens, one type of which is shown in an accompanying illustration. Although no records are available on the pressures carried on the mud pumps while drilling at the various depths, the range is from 500 lb. to 900 lb., the higher pressure being required in the 7-in. casing and when pumping cement. For ordinary drilling purposes the pressure is maintained at approximately 750 pounds. The weight carried on the drill stem varied from 2½ to 3 points in drilling the discovery well, and the range has been somewhat greater in the case of more recent operations, being from 2 to 5 points. Weights are watched closely, each rig being equipped with indicators for that purpose.

In drilling to 2100 ft. present practice in the field calls for 6-in. 25-lb. drill pipe; from 2100 ft. to 5600 ft., 4-in. 16.60-lb. drill pipe and for drilling-in, 3-in. 13.75-lb. drill pipe. Both regular and full hole tool joints are in use, and on the 3-in. and 4-in. drill pipe rubber protectors are employed to prevent wear on the casing. On the discovery well reamers were used from 200 ft. to 2100 ft., but none from there to the bottom of the hole. In subsequent wells both reamers and heavy drill collars are being employed.

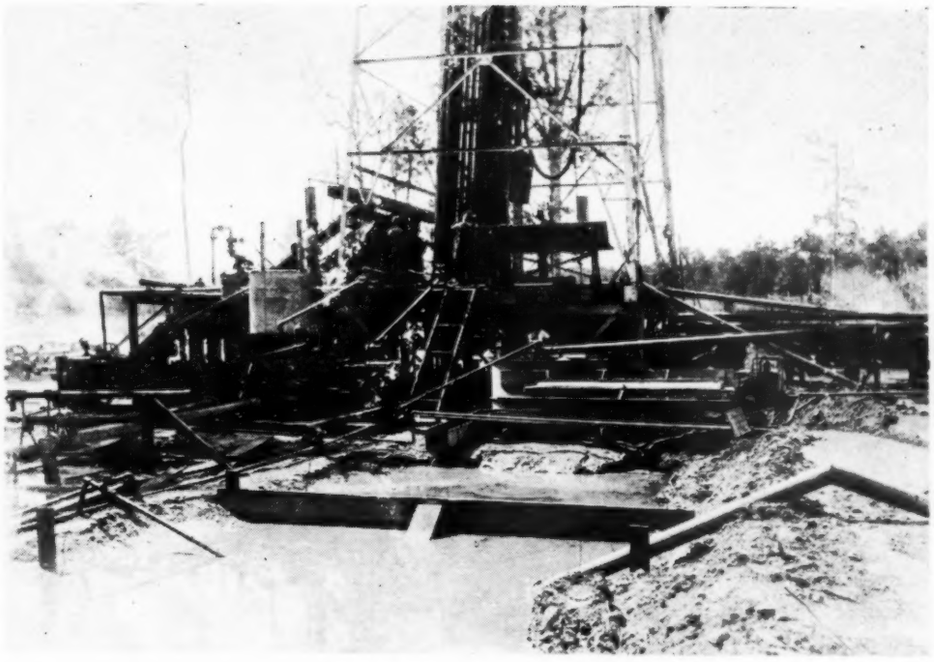
Various types of bits are required, drag bits, rock bits, etc. A recounting of the forms of bit used for drilling at various depths in the discovery well is of interest, as it gives some idea of the type of drilling encountered at the different levels. To 200 ft. a 23½-in. fishtail bit was used, from that depth to 2100 ft. 15-in. gumbo and 4-way drag bits came into play, from 2100 ft. to 4500 ft. 9⅞-in. 4-way drag bits and also rock bits were employed, from 4500 ft. to 5600 ft. the same type bits were used except that the size was reduced to 9 in., and for drilling-in a core bit cutting a 6⅛-in. hole was used.

In drilling this well, mud was obtained from the formation to a depth of 3300 ft., and from there on down special mud admixtures and weighting materials were necesary. This was especially true through the redbed series from 3300 ft. to 5600 ft., where some difficulty was experienced from heaving shale. At approximately 1500 ft. special mixing materials were required also, that formation being of a cavey nature. Instruments were employed constantly for determining the viscosity

The casing program used by the United Gas Public Service Company in drilling the discovery well called for the setting of 200 ft. of 16-in. O.D., 70-lb., grade C, range 1, surface casing; 2100 ft. of 10¾-in. O.D., 40.80-lb., grade D, range 2, seamless casing; 5610 ft. of 7-in. O.D., 24.30-lb., grade D, range 2, seamless casing; and 5555 ft. of 5-in. O.D., 15-lb. grade D, range 2, seamless casing. This latter string in the discovery well was set on top of the liner. Recent rules promul-



Christmas tree on the discovery well, United Gas Public Service Company's No. 1 I. Lee Young



No. 1 Thomas of United Gas, showing mud screen, slush pits, and mud-circulating pumps

gated by the Louisiana Conservation Commission have changed this schedule somewhat, and other operators have a program varying slightly from that of the United. One such calls for 250 ft. of 13-in. O.D., 50-lb., surface casing, approximately 2100 ft. of 9⅝-in. O.D., 36-lb. casing, and 5450-60 ft. of 7-in. O.D., 26-lb. casinng.

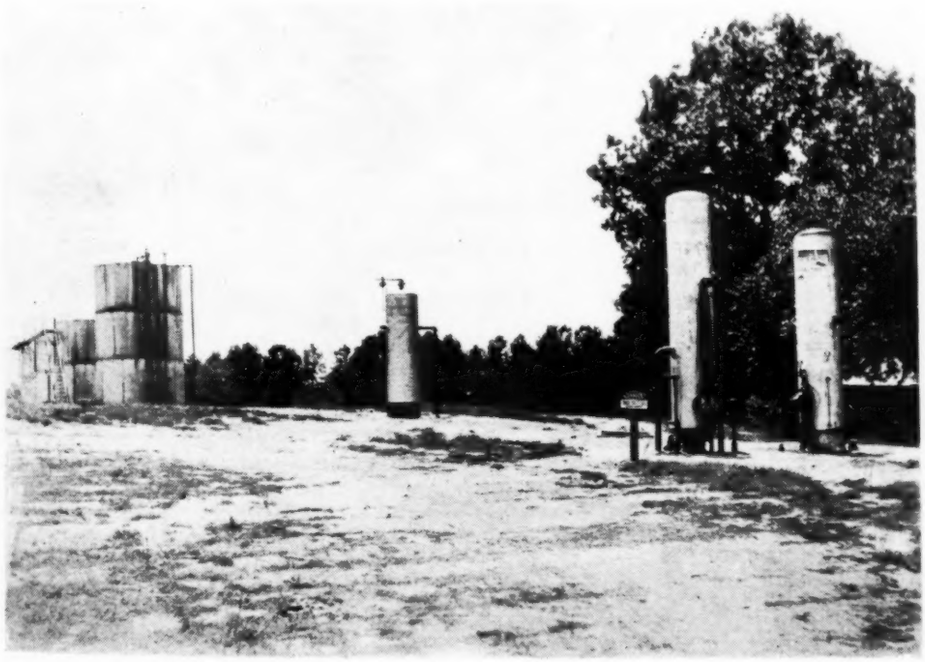
For spudding in the No. 1 Young well, United Gas carried a 23½-in. hole down to 200 ft., where it was reduced to 15-in. until a depth of 2100 ft. was reached. From 2100 ft. to 4500 ft. the size of the hole was 9⅞-in.; from 4500 ft. to 5610 ft., 9-in.; and from that depths to the bottom of the hole at 6048 ft., 6⅛-in. The company has adopted this program as its standard practice; however, the Haynes Production Company, which, other than the United, has the greatest number of rigs running in the field, is spudding in with a 19½-in. hole and carrying it to 250 ft., reducing it to 12¼ in. until a depth of 2100 ft. is reached, with a 8⅝-in. hole to be drilled from that point to 5450-60 ft., and completed with a 6⅛-in. hole.

No serious drilling difficulties have been encountered. The formations consist of surface clays, sand, shale, chalk, lime and anhydrite. Samples are taken from each formation, general practice being to catch cuttings on the base of the chalk rock, on top of the redbeds, and on the base of the anhydrite, cores being taken from the base of the anhydrite to the bottom of the hole. A rock bit type of core barrel is used.

Careful attention is given to maintaining a straight hole, and to accomplish this minimum weight is held on the bit, the drilling mud controlled, and the hole surveyed for deviation every 500 ft., a gyroscopic-type instrument being employed for the latter on the discovery well.

The multi-stage method of cementing was used on the discovery well. In that instance 250 sacks of cement were used to set the 200 ft. of 16-in. surface casing, 450 sacks for the 2100 ft. of 10¾-in. casing, 700 sacks for the 5610 ft. of 7-in. casing, and 50 sacks for the 5-inch. A Texas pattern plain set shoe was employed on the surface casing, a guide shoe on the 10¾-in., both a float shoe and a float collar on the 7-in., and a guide shoe on the 5-inch.

The discovery well was drilled in with rotary equipment, no cable tools being employed. During the procedure a steam- or water-controlled blowout preventer was installed on the casinghead. At the bottom of the hole 490 ft. of 5-in., grade C, range 2, seamless casing was set, 436 ft. being perforated, the remaining 54 ft. blank.



Following completion of the discovery well, it was euipped with one 16-in. by 10¾-in. O.D. fabricated-steel casinghead, one 10¾-in. by 7-in. O.D. slip-type casinghead, and one 7-in. by 5-in. O.D. slip-type head.

From the stock tanks the oil is being boosted by four 10x 4½x10 reciprocating steam pumping units eight miles through an 8-in. pipe line to the Ida, Louisiana, station of the Standard Pipe Line Company, and from there to the refinery of the Standard Oil Company of Louisiana at Baton Rouge.

Separators and tank battery at discovery well

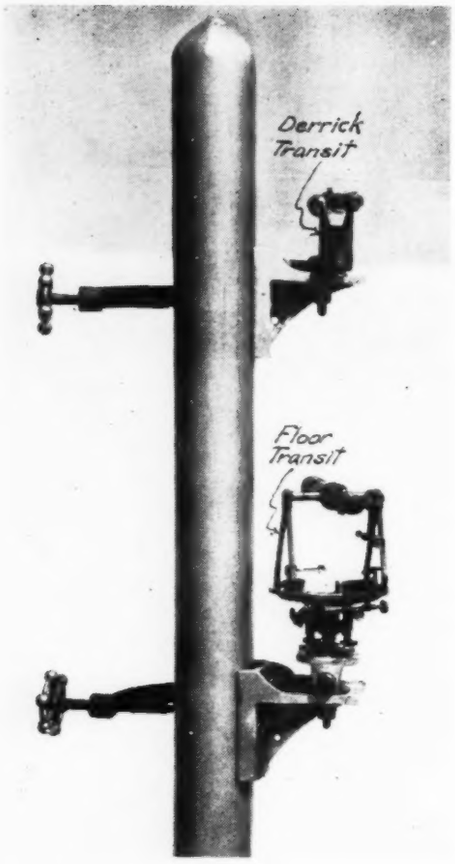


Fig. 6. Derrick and floor transits and clamps

Controlled Directional Well-Drilling and Surveying Practice

By

JAS. D. HUGHES

PART II

THERE are many who ask how a survey of a hole could be of any possible benefit. That a hole is either a well or it is not a well, only the bit can tell. This might possibly be true in the case of a wildcat in the middle of a 40,000-acre block; but in productive areas, particularly around a salt dome or in fractured and faulted areas, a survey from which corrective measures can be planned is often the difference between a dry hole and a well.

Surveys may be divided into two classes: (A) Operative, and (B) Informative.

In the operative class the surveys are made concurrently with drilling progress by means of a single-shot instrument. By taking a survey at 100-ft. or greater intervals, the operator can compute the position and angular condition of the hole as it goes down and have an active graphical chart for his guidance and possible later assistance.

It does not require a mathematician or an engineer to compute a single-shot survey. Anyone who can multiply or can lay a straight edge on an alignment chart can determine his plotting coördinates with very little trouble. The alignment charts can be obtained gratis from the company leasing the instrument, or the company will keep the survey up to date themselves at the wish of the lessee.

For the benefit of those readers who have never had occasion to calculate a single-shot survey the subject will be briefly discussed.

The object of each survey is to obtain a measure of the hole's angle of deviation and the direction at that particular depth, from which a point in three dimensions is determined that will locate that point in relation to the mouth of the well at the surface. The three dimensions are: true vertical depth, latitude, and departure. Latitude refers to the position of the point north or south of the well mouth while departure refers to the east or west position. The true vertical depth is the projection of the measured depth upon a line drawn vertically from the mouth of the well and is computed from the measured depth and drift angle.

Having taken the picture at a known measured depth and determined the angle and bearing, all that is required is a table of natural trigonometric functions, a sheet of coördinate or plain paper, and an engineers scale.

A convenient working sheet upon which to tabulate the computations is shown in Fig. 8 upon which is shown the working figures of an actual survey.

Under the column "Measured Depth" is placed the depth at which the survey was taken. The "Course Length" is the distance or interval between surveys. Under "Drift Angle" is placed the observed angle of deviation. The natural functions of this angle are taken from the tables and placed under their respective columns. The "Vertical Depth" is the product of multiplying the "Course Length" by the cosine of the "Drift Angle". The "True Vertical Depth" is the cumulative sum of the vertical depths. The "Course Deviation" is the product of the "Course Length" and the sine of the "Drift Angle." This is checked by multiplying the "Vertical Depth" by the tangent of the "Drift Angle". The "Deviation" is the number of feet that particular point is out laterally from the vertical of the preceding point.

Having gained the measure of deviation it now remains to project it upon the two directional axes, the north-south and the east-west.

Under the "Drift Direction" is recorded the true bearing of the survey. The functions of this angle are tabulated in their respective columns as before. The "Latitude Difference" is the product of the cosine of the bearing angle and the "Course Deviation". Its position north or south is indicated by the bearing. The "Departure Difference" is the product of the sine of the bearing angle and the "Course Deviation" and its position east or west is also indicated by the bearing. These results are checked or proven by the tangent as before. Under

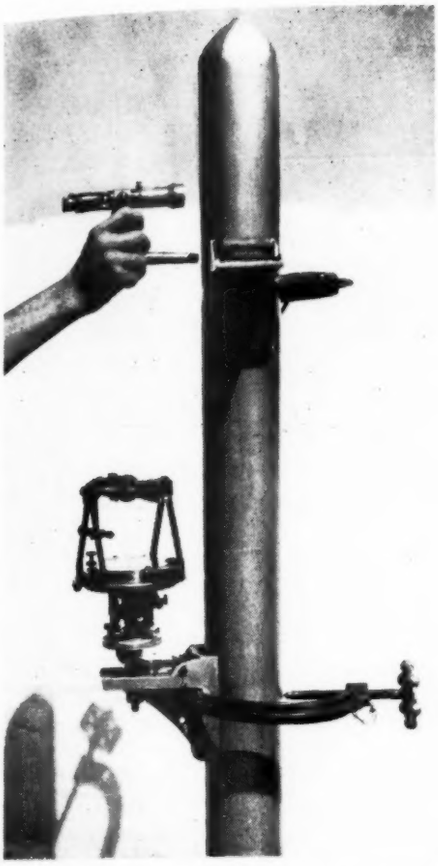


Fig. 7. The upper view shows the derrick (upper) transit being inserted in the clamp. Lower view shows the floor (lower) transit in clamp

the "Total" columns are placed the cumulative northings, southings, eastings, or westings, such totals being the plotting coördinates for that survey.

Choosing a major intersection on cross-section paper as the base of the coördinate system, the abscissa is laid off as the north and south axis and the ordinate as the east and west axis. The successive stations are then plotted on this system from the figures in the "Totals" and connected by straight lines or preferably irregular curves that fit the configuration of the points.

The plat thus obtained is the view one would obtain if it were possible to see the entire hole while looking directly down upon it from a height. If the hole were absolutely vertical only one point would represent the course of the entire hole.

The vertical section can be obtained on either the north-south or the east-west plane by plotting the true vertical depth of each station against the total northings and southings and/or eastings and westings.

Table 1 is a handy tabulation showing

Fig. 8. Work sheet with tabulated computations of an actual survey

TABLE 1

Showing Deviation and Loss of Depth Per 100 Feet of Measured Depth

Angle	Deviation	Loss in Depth	Angle	Deviation	Loss in Depth
0°15′	.44	.00	5°15′	9.15	.42
0°30′	.87	.00	30′	9.58	.46
0°45′	1.31	.01	45′	10.02	.50
1°00′	1.75	.02	6°00′	10.45	.55
15′	2.18	.02	15′	10.89	.59
30′	2.62	.03	30′	11.32	.64
45′	3.05	.05	45′	11.75	.69
2°00′	3.49	.06	7°00′	12.19	.75
15′	3.93	.08	15′	12.62	.80
30′	4.36	.10	30′	13.05	.86
45′	4.80	.12	45′	13.49	.91
3°00′	5.23	.14	8°00′	13.92	.97
15′	5.67	.16	15′	14.35	1.03
30′	6.10	.19	30′	14.78	1.10
45′	6.54	.21	45′	15.21	1.16
4°00′	6.98	.24	9°00′	15.64	1.23
15′	7.41	.27	15′	16.07	1.30
30′	7.85	.31	30′	16.50	1.37
45′	8.28	.34	45′	16.93	1.44
5°00′	8.72	.38	10°00′	17.36	1.52

the deviation and loss of depth per 100 ft. of measured depth for drift angles up to ten degrees.

Fig. 9 is a handy nomographic alignment system that permits rapid approximations sufficiently accurate for field use; it is self explanatory.

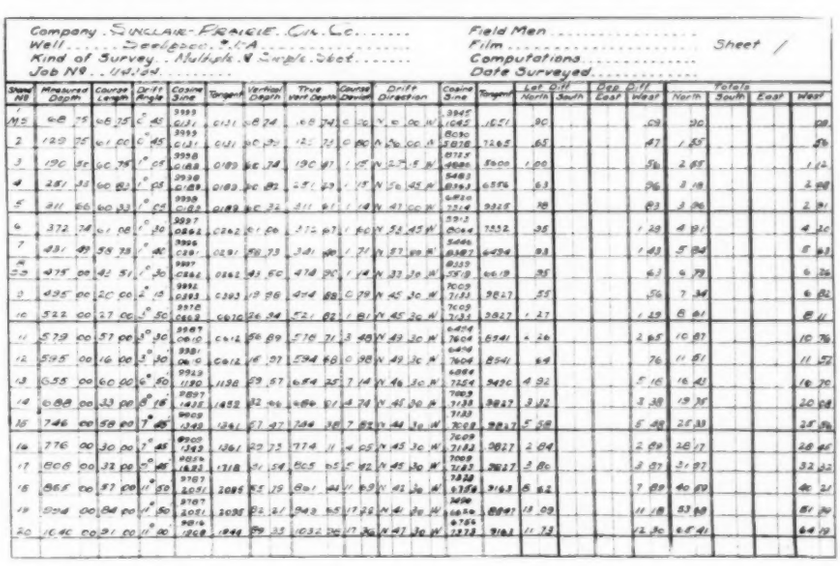
In the methods just discussed it has been assumed that the course length is a straight line or the hypotenuse of a right triangle whose angle is the angle of deviation, and that this angle exists throughout the course length.

This is not strictly true because the angle increases or decreases gradually during the course of drilling. In instances where the interval between surveys is considerably greater than 150 ft. or where the angular change is considerable the survey should be balanced by assigning averaged angular increments to equally spaced sections of the course length. Large changes in direction should be similarly balanced.

Where the interval is around 100 ft. the results are as precise as can possibly be obtained consistent with good practice, which necessarily considers time and expense.

It is the writer's observation that a drilling well is an unknown quantity and a continuous threat until casing is successfully landed. There is always the possibility of a twist-off, a stuck string, or a fishing job of some description. In many of these cases recovery is a long and expensive operation. It has many times proved less troublesome and expensive to set a cement plug on top of the fish and sidetrack by means of the removable whipstock; in which case, prior knowledge of the direction of the old hole will permit sidetracking in a direction that will insure the new hole from running back into the old hole, as so often happens.

There have been two particular instances in the writer's experience where



an existing directional survey could have saved a total of more than 8000 ft. of hole.

In the first instance a core barrel in being withdrawn stuck some 4000 ft. off bottom and the drill pipe had to be shot loose. Had a survey of the hole been available, the chances of sidetracking and coming back into the old hole below would have been good enough to justify the attempt, particularly in view of the prospect of skidding and drilling to 8000 ft. again.

The other instance was occasioned by the bottom joint of the surface string breaking off and lodging some 80 ft. farther down the hole. The joint was sidetracked in attempting to work into it and a new hole started. A number of whipstocks were set, guessing where the old hole might be but due solely to lack of prior knowledge of the position of the old hole the attempts were not successful.

To illustrate the precision that can be applied to this phase of directional drilling when the position of the hole is known from previous surveying, the following instance is cited.

The writer's company had been retained by an operator in the Barbers Hill field (Texas) to orient a casing whipstock and after milling out to direct the workover hole.

This was done, the sidetracked hole deflected some 250 ft. to its objective and preparations made to run casing. At this stage trouble developed with the casing whipstock to such a point that it was impossible to get through the "window." It was decided to orient and set a second casing whipstock in the joint above the first.

After milling out and drilling 30 ft. into the formation a single-shot survey revealed this new hole to be bearing 11 deg. to the right of the original sidetrack hole. It was calculated that an intersection of centers could be obtained in 11 ft. by setting an Eastman removable whipstock around 25 deg. to the left. The whipstock was set and after seven ft. had been made below, the bit fell away into the objective hole, which was reamed on down to bottom and successfully cased.

Operative surveying is a boon to the operator who must drill a well within specified angular limits. Particularly will it be a boon to the long-suffering contractor who, having drilled the hole, finds that he must plug back and straighten up—a modern variation of locking the barn door after the horse has been stolen.

By having a single-shot survey at reasonably regular intervals he has advance notice of a wells' tendency to go seriously off vertical. He has ample time and opportunity to alter his set-up so as to correct the tendency; if, after another check survey, it is found the hole has not straightened up, a removable whipstock can be set on bottom right then and the hole brought back to vertical without the expense of plugging back and redrilling.

In summation then, operative surveying permits the operator to take corrective measures at the time they will be most effective and at a minimum expense and trouble.

Informative surveys may be described as those multiple-shot surveys taken after a well has been drilled to:

(1) Determine, if in a semi-proven area, why it missed.

(2) Locate its position on the structure as an aid in determining other locations.

(3) Determine verticality and the most favorable plug-back point from which to straighten.

(4) Determine the most favorable point at which to begin remedial directional drilling.

(5) Determine the point and direction to set a casing whipstock in a work-over in order to employ directional drilling to a better producing area on the lease.

(6) Determine the course and angular condition of the well as a matter of engineering and geological knowledge to aid in future calculations.

One major company has adopted the policy of drilling the hole and surveying down to the deepest known pay, running an electrical logging device, running casing, and then plugging back and whipstocking out to each of the upper pays in succession after the lower has become depleted.

CORRECTION. On p. 30, July issue, eighth line from top in right hand column, read Figs. 6 and 7; in right hand column on same page and second and third lines below table SURVEY "A" read Figs. 4 and 5.

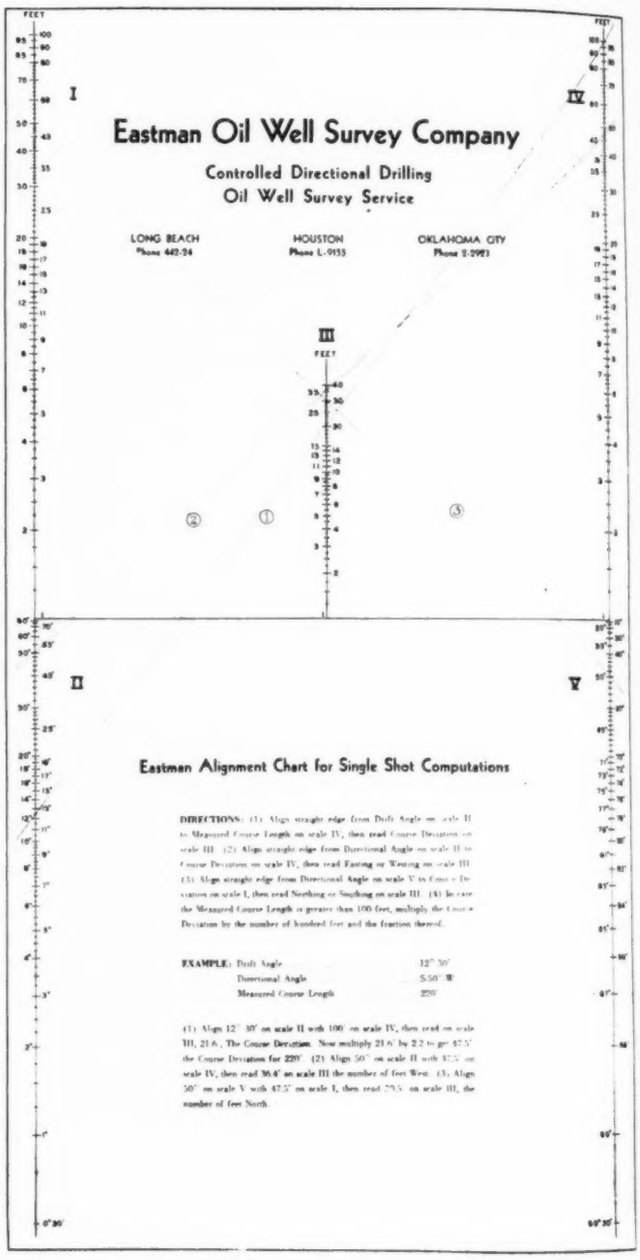


Fig. 9. Alignment chart for rapid computation in the field

Travelling type machine specially designed for cleaning large diameter pipe

By FRANK H. LOVE

Speed Characterizes Reconditioning of Large Diameter Gas Line

Specially-designed equipment aids in salvaging of 20-inch pipe line by the Lone Star Gas Company in Texas

THE Lone Star Gas Company's project of reconditioning 98 miles of 20-in. pipe on an unused line between Birdville, Texas, near Fort Worth, and Petrolia in Clay County, Texas, has been characterized by the speed and facility with which the work has been accomplished. But one major difficulty has been encountered — the effect of the heat. The pipe, when originally laid was coated with hot enamel and cold coal tar, and at midday with the torrid Texas sun bearing down, the coatings become pliable and "gum up" the brushes and cutters on the cleaning machines. This factor has made it necessary, except on cool days, to run the machines only at night and until about 11 a. m.

The pipe, having been in the ground only since late in 1929, is in reasonably good condition, another factor aiding in the speed of the job. The stock, A. O. Smith pipe, is of 9/32-in. thickness, weighing approximately 60 lb. to the ft., with the longitudinal seam electrically welded.

Two crews are being employed, working from either end of the line. The gang on the north end began work July 3, the one on the south end July 12. It is expected that the entire 98 miles of pipe will be entirely reconditioned by September 1.

Following the flagging of the line, the procedure has been to uncover the pipe with Buckeye ditchers. Two ditchers are in use, one a Model 48 Special. This machine is of interest because of its unusual size. Cutting widths are 24 in., 28 in., 32 in., 34 in., and 36 in., with the maximum cutting depth eight ft. six inches. Overall dimensions are: width, 10 ft. 5½ in.; length, 44 ft.; height, 13 ft.; wheel base, 17 ft. 4 inches. It is equipped with a power steering device, lever controlled, with the steering transmission encased in oil. The cutting wheel is of extra heavy construction, being made of 1-in. by 7-in. steel plate to which is double-riveted manganese segments geared with a circular pitch of 3⅛ in. center to center. The machine has two complete ranges of digging feeds, each having four speeds, giving a choice of eight speeds, from 15 in. per minute to 134 in. per minute. The ditchers having dug down to the top of the pipe, manual labor is employed to remove or loosen the soil from around it, leaving it in condition to be hoisted above the trench.

The hoisting operation is accomplished effectively with tripods and Coffing hoists, shown in action in an accompanying illustration. The equipment is light, making it easily movable from one location to another. At the hinge of the legs of the tripod a clevis is provided for rapid and convenient attachment of the hoist. The hoist operates on a straight ratchet principle, pump handle style. The pipe is raised by short strokes of the handle from either side. This equipment can be used for lowering pipe into the ditch as well as raising it, and for that purpose a small lever is attached to the side of the hoist frame for controlling the movement up or down. The hoists used on the Lone Star reconditioning work were specially designed for this particular job by Crutcher-Rolf-Cummings, Inc., Houston, Texas. They are 6-ton hoists equipped with three chains, making their lifting speed 15 in. per minute, or 25 percent faster than the regular 6-ton hoist equipped with four chains.

With the pipe lifted and placed on skids above the trench it is ready for cleaning. Being a solid welded line this opera-

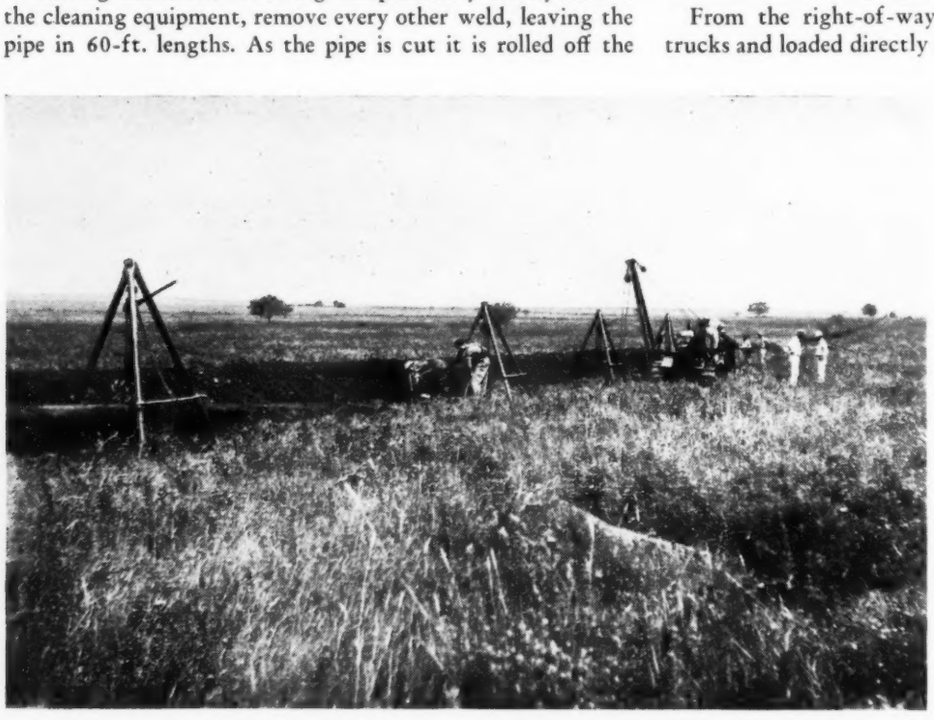
Ditching machine uncovering pipe

tion is accomplished entirely with the use of traveling-type machines that ride the top of the pipe. Since this method is available the reconditioning work is greatly simplified; it is not necessary to remove the pipe in sections to centralized reconditioning yards, thus reducing the amount of handling required and, likewise, the time necessary for completing the job.

As the cleaning machine progresses along the line a Caterpillar 50 tractor equipped with winch and boom lifts the pipe off the skids, permitting it to pass unimpeded. The machines are W-K-M Model D's, two of which were specially constructed for this job and designed for cleaning large lines. They can be adjusted to accommodate 12-in. to 20-in. pipe. The machines are equipped with special scraper knives for removing coatings and carry 480 cutters and 12 brushes. In high gear they have a speed of 16 ft. per minute. Four speeds forward and four reverse are provided, the machines being powered by a V-8 gasoline engine. The reverse action, of course, is needed when pipe is in such condition that it is necessary to pass the cleaning machine over it more than once to remove the dirt, scale, coating, etc. On the Lone Star job, however, the cleaning, except in rare instances has been thorough with one action of the machine. Each machine has cleaned an average of one mile per day of two shifts. In instances as much as three miles have been cleaned in a single day by one machine. The machines are easily installed on, and removed from, the pipe and negotiate overbends, sags, and sidebends with facility.

Cutting machines, following comparatively closely behind the cleaning equipment, remove every other weld, leaving the pipe in 60-ft. lengths. As the pipe is cut it is rolled off the skids by hand onto the right-of-way, out of the path of the backfillers. The type of cutting machine in use severs the pipe and bevels it in one operation, preparing it for welding when relaid. They are manufactured by Harder & Mathey, Tulsa, and distributed by the Welders Supply Company of Dallas and Tulsa. Two machines are being used, each operating two cutting torches. The bevels are made at a 30-deg. angle, although adjustments can be made for a bevel of any degree. The equipment is clamped to the pipe by means of boomers and travels on its own track, which is stationary at all times. It can be regulated to cut and bevel pipe of from 14 in. to 20 inches. On the 20-in. pipe one complete operation (two cuts and bevels) is being accomplished in an average of three and a half minutes, the two torches operating simultaneously, cutting on each side of the old weld. All torch tips have been recessed to adapt them to the use of Stargas, a product of the Lone Star Gas Company that is being used as a cutting fuel.

From the right-of-way the pipe is being picked up by trucks and loaded directly onto freight cars for transportation to points along the route of a new line being laid by the Lone Star Gas Company from the Cayuga and Long Lake gas fields in Anderson County, Texas, to two points near Dallas. It will connect at Irving, 20 miles west of Dallas, with lines from the Panhandle and Oklahoma, and at Joshua, southwest of Dallas, with carriers from West Texas fields. Contracts for the construction of this 109-mile line, estimated to cost approximately $2,225,000, were awarded recently. The Oklahoma Contracting Company, Dallas, of which Tom Jones is the head, was given 67



Hoisting the pipe above the trench, preparatory to cleaning

Cutting the pipe into 60-ft. lengths

miles of the line from Irving to a point between Kerens and Trinidad. Ford, Bacon and Davis, Inc., New York and Dallas, will construct the 42-mile section from that point to the Cayuga and Long Lake fields.

The new line, tapping two of the newest gas fields in the state, will cross three counties and part of a fourth. Starting at the Long Lake field in southwestern Anderson county, it will follow the general northwestern course of the Trinity River to the Cayuga field in northwestern Anderson county. It will cross the Trinity north of this field and pursue a northwesterly course through the counties of Navarro, Ellis, and into Dallas county. Construction already is under way and completion of the work is anticipated for December 1st.

The line will be a combination welded and coupled one, a Dresser coupling to be used every 120 feet. It will be coated with hot enamel and wrapped with asbestos felt over its entire length.

With a maximum daily capacity of 110,000,000 cu. ft., this new line will increase the reserve gas supply against peak demand more than 35 percent for Dallas, Fort Worth, and other cities on the Lone Star Gas Company's system.

No new booster stations will be required, rock pressure being sufficient to operate the line. Pressure on the wells in the Cayuga field is 1500 to 1600 lb., and on the Long Lake wells 2000 pounds. Both fields are comparatively new, the discovery well being brought in at Long Lake during the fall of 1933, and at Cayuga in the spring of 1934. When completed the line will be operated on a pressure of 400 to 450 lb., officials of the Lone Star Gas Company have stated.

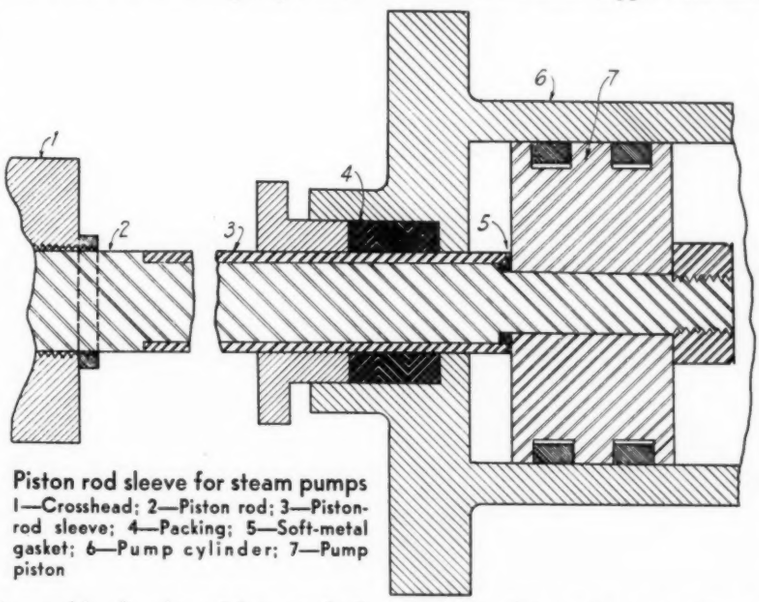
Repairing Corroded Pump Rods

By JOHN V. EARLY

WHERE uninterrupted operation is required either in transfer or planning service, problems are confronted by most refiners, due to the failure of steam pumps. Such failures are costly and in some instances, such as in continuous batteries, the operation is upset to such an extent that the resultant shutdown is especially costly.

Probably the most serious problem in handling technical naphthas or gasoline or raw products in general, is the corrosion of the pump rods on the liquid end, which eventually become so pitted and roughened as to render a new packing of no benefit, because of the abrasive action of the corroded rods. To overcome this handicap the piston rod sleeve is the easiest and by far the quickest method of repair; also the cost of this sleeve compared with the cost of a new pump rod represents a substantial saving.

This rod sleeve is nothing more than a tube of the correct outside diameter required for the pump in question. The regular piston rod is turned down to the diameter necessary for fitting a tube or sleeve of the required size. The sleeve is then slipped over the turned-down piston rod. A soft metal gasket, preferably aluminum, is then fitted to the end of the sleeve and is held securely in place by the pump piston. (See accompanying drawing).



Piston rod sleeve for steam pumps
1—Crosshead; 2—Piston rod; 3—Piston-rod sleeve; 4—Packing; 5—Soft-metal gasket; 6—Pump cylinder; 7—Pump piston

This method of combating corrosion of pump rods will be found to be most satisfactory and will remove many long interruptions in plant operation because of the speed with which the repair can be made.

Stainless steel has been found a suitable and satisfactory metal for the sleeves because of its long life in this type of service. In most severe service conditions, Monel steel has been found to be even more resistant. In milder service, a money-saver is available in the use of Admiralty tubing that has been discarded from condenser equipment.

The Manufacture, Packaging, and Shipping of Oxidized Asphalts

By CHAS. J. HOLLAND Article 7

PRINCIPLES OF DESIGN AND OPERATION (Continued)

WE come now to principle No. 6—the use of a large number of stills per battery. There is no theory about this; it is entirely experience. But there is a theoretical explanation that fits well the experience.

The experience is this: With eight stills per battery in Plant No. 1 there was the equivalent of one or two down all the time, especially when making asphalts of over 250 deg. fahr. M.P., for cleaning and repairs. That is, on the line in continuous operation all the time were six or seven stills. This gave good results on constancy of product quality and the possibility, when desired, of making simultaneously and continuously two grades of asphalts.

At Baku 3½ years ago the writer urged the management to build a battery of stills similar to those at Plant No. 1. They did not at the time agree but after his return to Moscow headquarters they tried to put the writer's ideas into practice on four old batch converters they had been using for years. They held about 1,000 bbl. each of charging stock.

On them they put a gravity flow line and attempted continuous operation. They did not have any success. Product quality was poor, was not uniform, temperatures went up and down, and other things happened. After three or four months of effort they wisely gave up. The writer believes the trouble, aside from the drawback of inexperience with continuous operation, to have been: First, there was three or four times too much charging stock in the system to keep product output down to a practical operating figure of around five tons per hour for high melting point asphalts; second, when the stock in the last still, due to slight, unavoidable variations in operating conditions, became off-test, up or down, they had such a large volume of it that it was futile to attempt correction of tests by the customary means, even had they known of them. The result was that each time this occurred they either had to run out into the receiving vessels a lot of off-test material or else shut off and operate all stills by batch-running.

From these two experiences and the theory behind them, the writer has concluded, and other experts agree, that there should be in a continuous unit not three or four large stills but six, seven, or eight small ones when designing for a product output of not over five tons per hour. This principle is of particular importance where high melting point products are to be made, because of the unavoidable necessity for frequent cleaning of the last two or three stills. Under such conditions there is a rapid formation of coke especially in tops of these stills and if they are not frequently cleaned the air spiders, flow line, and vapor lines tend to become plugged and of little use to the system. At the same time, solid coke particles appear in the finished products requiring troublesome screening to avoid contamination of asphalts made.

Principles Nos. 7, 8, and 9

These three, like 4, 5, and 6, are so interrelated their discussion may be best carried out together.

By No. 7 is meant there should be provision for outside oil-heating or gas-fire-heating on bottoms only of all stills in a battery regardless of whether there is continuous need of it, in preference to a more complicated and less practical heating system, such as the use of closed pipe coils inside of stills through which would be circulated a heating medium such as hot gas oil, asphalt, or fuel oil.

The writer suggests heating of bottoms only because it is not practical to continue the heat up around the sides for a short distance. It would expose the circumferential rivet rows to the fires, making necessary occasional expensive repair work that otherwise would be avoided; furthermore, it would increase considerably the costs of foundations and fire boxes.

The reasons why this system of heating is recommended and why for all stills in each continuous unit, are sufficiently well stated in Article No. 3 under the heading of Oxidizing Stills, that no additional explanation seems necessary.

The reasons for Principle No. 8 are more or less self-evident. If stills and flow line are all not on the same level with reference to ground elevation, they would have to be placed in cascade arrangement, as was done with the Baku stills. The only thing to be gained by cascading is a little extra room in the first three or four stills. This advantage cannot be justified when regard is had for the additional capital investment and maintenance costs that are known from experience to be required, as compared with level still settings and flow line.

No. 9—Mechanical Agitation

A detailed discussion on reasons favoring a means for mechanical agitation of liquid in stills is intriguing but time and space for this in this series of articles do not permit it. Only the high spots will be touched.

Historically, the writer first learned of these reasons through an accident. The Plant No. 1 stills when taken over for oxidized asphalt manufacture had been in another service where a paddle stirring device was essential. With this means for mechanical agitation available at no additional cost it was used from the beginning. At different times during the writer's two years of work in the plant the stirring was stopped for short intervals either because of mechanical difficulties or simply to observe results. It was soon learned that when not running the paddles with their chain drags there was considerable loss in product output; that its quality was less uniform; that more air and fire heating were required; and that coke formation was greater in the stills, especially in those that were fired for any length of time. Having had this experience one does not need the support of experts or theory to justify belief in soundness of Principle No. 9. But we have it anyhow.

The theory is: First, that in the outside fire heating of vessels containing asphalt-like products there are little or no convection currents set up to carry the heat uniformly throughout the liquid body, as is the case with similar heating of other liquids such as water and the lighter petroleum products. The air percolation helps some but very little. Consequently, when a mechanical stirring device inside the still is not used there will be material increases in coke formation; in frequency of still and air spider cleanings; in increased still

bottom repairs, and increased fuel oil consumption. In other words, considerable decrease in product output and increased operating and maintenance expenses.

Second, it is obvious that finished product uniformity will be better with mechanical agitation than without since there will be better mixing in each still of the oxidized, the partly oxidized and the non-oxidized portions of the liquid body.

Third, expert opinion, theory, and practice show that much less air is required per ton of product output where there are means for mechanical agitation. This is because of breaking up of air currents from the air spiders in bottoms of stills into smaller bubbles, thus giving more intimate mix and a longer time element. These two advantageous factors are intensified in that with the whirling around of the liquid body the air bubbles do not take the quickest and shortest route out of the liquid such as they do without mechanical agitation. They take a slower and more tortuous route out toward the periphery of the vessel. This is why the writer stated in discussion of diameter-height ratio that liquid depth in stills thus equipped is not important.

The purpose of air is to give up its oxygen content (about 20 per cent) to the liquid in the stills. In the first stills and once oxidation temperature has been reached, it does this quickly and the resulting chemical reaction is a rapid one. For in these stills there is continuously present materials practically unoxidized, so that from viewpoints of time of oxidation (i.e. throughput) and reduced air consumption, mechanical agitation is not important. But with the remaining stills, and increasingly so as the end of the battery is approached and where high melting point products are being produced, conditions are just the reverse. Hence the importance and utility of mechanical agitation for increased capacity and reduced air consumption, become increasingly apparent in the last four or five stills of a continuous unit.

There are several commercial means of accomplishing mechanical agitation. They will be listed and discussed in a subsequent article.

Principle No. 10—Use of Reflux System

This refers to a scheme for utilization in a continuous unit of the excess exothermic heat of the air-oil reaction and to do it without closed coil heat-exchangers. It offers a means of heat and air conservation, flexibility of control, and improvement in quality of product.

It is something the writer has tried out successfully on a laboratory scale but has not as yet had opportunity to put into practice commercially. So far as the writer has been able to find out, it has potential possibilities of great practical utility; is a quite novel idea, and therefore patentable. When the writer explained it to other experts they were enthusiastic about its great value for continuous asphalt oxidizing units.

For illustration and quick appreciation of the merits of this principle, assume a battery exactly like those of Plant No. 1 operating on same charging stock, making the same asphalts, and in all other respects the same as they were. Assume further a Kinney rotary pump with its suction connected up to the end of the flowline immediately after the eighth still and its discharge connected to the line of the incoming charging stock immediately ahead of the first still. Assume still further that this pumping operation is taking place at the rate of one ton per hour of finished product from last still back to the first one. From Table 7 it will be seen the result to be expected is a 20 per cent increase in output of finished products. Another way of stating it is that under Plant No. 1 conditions this reflux system will take the place of 1¼ stills.

That is the chief but not all the advantage to be gained. Instead of one ton the re-circulation rate may be increased or decreased easily, quickly, and effectively, thus affording an ideal and excellent means of control of quality of product. For example, assume that due to some abnormal operating condition the continuously flowing stream from the last still suddenly begins to run too high in melting point. In that case, instead of producing off-test material to the receiving vessel, the reflux pump would be speeded up so that all the eighth still output would be returned to the first still, or if desired, to any other still, or partly to any other still, by means of a suitable manifold on the pump discharge. As soon as conditions were corrected the reflux pump would again be set to normal operation. The other extreme would be some equally sudden and transitory difficulty with product of too low a melting point, in which case the reflux pump would be either slowed down or stopped until normal conditions again were set up. No other system imaginable could be so simple and flexible in this respect and at the same time so conducive toward increased product output and reduced consumption of air and fuel.

Finally, the writer contends that the application of this principle will reduce air and fuel consumption and assist toward higher quality of product because it is a complement to, or substitute for, mechanical agitation and its well-known benefits, because it doubles (more or less as desired) the rapidity of movement of liquid through the stills. It is, as we have already seen, fast movement of liquid through and in the stills that makes for reduced air and fuel consumption and improved quality of product, and adds an argument in favor of stills of small diameter-height ratio.

TABLE 7

Battery of Eight Stills of Plant No. 1

Battery Conditions	Without Reflux System*	With Reflux System**
Temp. of charging stock	200° F.	300° F.
" " Still No. 1	300	400
" " " " 2	350	450
" " " " 3	400	520
" " " " 4	570	570
" " " " 5	570	570
" " " " 6	570	570
" " " " 7	570	570
" " " " 8	570	570
Bbl. of chg. stock/hr.	13.4	16.1
" " " " /day	321	386
Tons of asphalt /hr.	2.08	2.50
" " " /day	50	60
Percent increase		20%
Sq. ft. metal/ton asph./day/battery	75.4	62.8
Percent decrease of metal requirements		17.7%

*See Article 3 and Table 5.
**Calculated results.

Calculations:

WORKING TIME EFFICIENCY

	Without Reflux System	*With Reflux System*
	5 Stills @ 100%	6 Stills @ 100%
	1 Still @ 75%	1 Still @ 75%
	1 Still @ 25%	1 Still @ 50%
	1 Still @ 0%	
Equivalent to - - -	6 Stills @ 100%	7¼ Stills @ 100%

$\frac{2.08}{6}$ equals 0.35 tons asphalt per still per hour; hence for 7¼ stills it equals 2.08 plus (0.35 x 1.25) equals 2.50 tons asphalt per hour per 8-still battery with reflux system; 2.50 x 24 equals 60 tons asphalt per day.

The working time estimates are based on the combination of the temperatures and of the presumed conditions of the liquid bodies in each still with respect to their percent saturation of oxidized bodies. In the last five stills of the battery without reflux the saturation may be assumed at 100 percent, hence all have actual working time efficiencies of 100 percent. Still No. 3 with temperature of 400 is assumed to be at 75 percent for reasons of low temperature and nearness of beginning of battery. Similarly, for No. 2. No. 1 at 300 temperature is serving simply as a pre-heater and is below initial oxidizing temperature, hence it works at 0 percent efficiency. With battery of reflux system the last six stills may each be calculated with a working efficiency of 100 percent. The last five are at the maximum allowable temperature while No. 3 at 520 is sufficiently hot to be at 100 percent efficiency when

regard is had for the fact that it contains liquid of not so much saturation of oxidized bodies. On the same reasoning stills Nos. 2 and 1 are assumed to be at 75 and 50 percent respectively.

Principle No. 11—Receiving Vessels

For high melting point asphalts made from continuous gravity-flow units, the length-depth ratio and other characteristics of receiving or drum-filling vessels are dependent to some extent upon ground topography, heights of stills and settings, distance from last still and methods employed for filing, handling, and shipping of packages.

There must be of course a difference in height of one to three ft. between flow-line outlet of last still and tops of receiving vessels for otherwise gravity flow would not be possible, and the receiving or drum-filling vessels must be set at sufficient elevation above floor of filling shed to allow for gravity flow of asphalt from bottom of vessels into the drums; also, if railway car loading of filled drums is to be done by hand labor some provision should be made for having the floors of the loading shed and the cars on the same level, in order to reduce labor loading costs. This may be done by either an elevated shed floor or countersunk railway siding or partly by both. Evidently, ground topography, heights of stills and settings, and distance from last still, all have much to do with maximum allowable depth of vessels. Their combined effect is such that almost always the depth must of necessity be shallow.

This and two other important reasons for shallow depth and great length of drum-filling or receiving vessels are given in detail in Article 3 on Stills and Receiving Pans, rendering further discussion of them here superfluous.

That part of this principle relating to need for arrangement for oil-heating or gas-fire-heating of receiving vessels is likewise sufficiently well described in Article 3. If only low melting point asphalts are to be made then this could be dispensed with but seldom if ever would a continuous oxidizing unit for any great length of time be thus restricted as to type of product output. While closed live steam coil heating is adequate and practical for the low melting point asphalts it is essential to have a hotter medium of heat transfer for products of 250 M.P. and over. For them the simplest, most efficient, and most practical medium is oil-heating or gas-fire-heating as described in Article 3 and as illustrated in Fig. 3.

Principles Nos. 12, 13, 14, and 15

Though these are not interrelated, need of explanation and discussion is not great for any one, so that their grouping under one heading should not prove confusing.

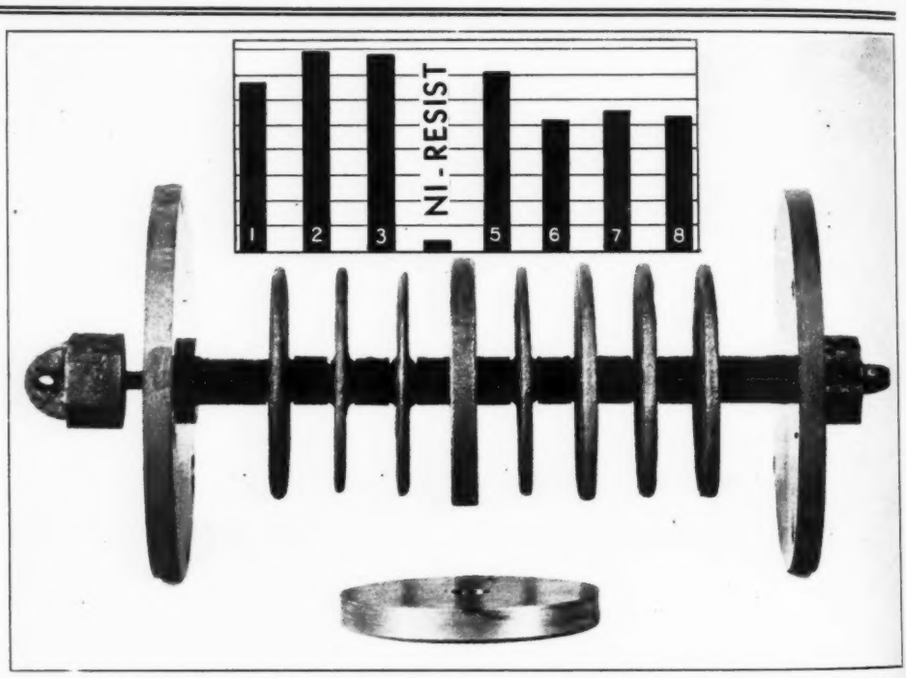
It is easy to realize the possibility for simultaneous production of two or more grades of asphalt from each continuous unit. It may be accomplished by the simple expedient of drawing one out of the last still and another of lower melting point from the next or second to last still. This can be done by having the necessary manifold connection to flow-line and receiving vessels in the same well-known manner as is sometimes done when making continuously two grades of fuel oil from one crude oil shell still distillation battery.

Similarly, if it is desired that one of these grades be a steam-refined product and the other an oxidized asphalt — either 100 percent or partly in either case — it may be done by use of steam or air in the air spiders of the appropriate stills in the battery and by use of correspondingly appropriate temperatures. Where steam refining is to be done in whole or in part, temperatures of liquid in the stills involved should be considerably higher than for those being oxidized. Incidentally, this is another reason favoring Principle No. 7 — all stills equipped for oil-heating or gas-fire-heating.

Explanation of use of removable ring to avoid "topping off" and discussion for mechanization of drum filling equipment may be best left for inclusion in a subsequent article.

"Ni-Resist" Cast Iron for Handling Acid-Treated Naphtha

THE International Nickel Company, Inc., recently made tests with its product, "Ni-Resist" cast iron, to determine its value in the handling of acid-treated naphtha. The accompanying illustration, interpreted graphically, shows the results of the test. The test spool shown, originally containing samples of the size and shape illustrated by the single specimen, below spool, was submitted for 78 days to the action of a rerun acid-treated naphtha stream at a temperature of 100 to 110 deg. fahr. in a southern oil refinery. The analysis of the various samples, together with the actual individual weight losses, are shown in the accompanying table. It will be noted that this spool assembly provides electrical insulation between the various samples as well as the equipment in which the tests were made.

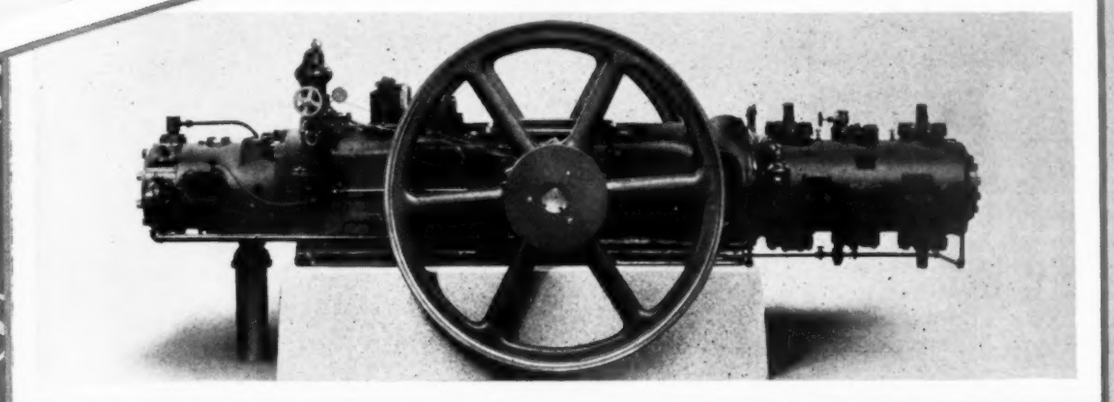


Corrosion of Various Types of Cast Iron Condition: Rerun, Acid-Treated Naphtha Time: 78 days

Specimen	Analysis					Original Weight-Grams	Weight Loss Grams	Penetration Inches Year
	TC	Si	Ni	Cr	Cu			
1	2.81	1.86	2.07	....	....	114.2594	66.0348	0.2657
2	3.41	1.99	....	....	....	112.0426	79.2486	0.3194
3	3.40	1.55	1.26	0.50	....	112.3632	77.6780	0.3119
Ni-Resist	**3.11**	**1.51**	**13.70**	**2.36**	**6.06**	**115.4949**	**4.8604**	**0.0192**
5	3.44	1.65	3.00	0.51	1.25	110.4079	70.1931	0.2823
6	3.46	2.47	0.55	0.81	....	110.1835	51.3351	0.2073
7	3.29	2.73	2.71	0.76	....	111.6433	54.3135	0.2203
8	3.01	0.94	3.24	....	....	115.8299	53.8922	0.2141

Now.. SMALL QUANTITIES OF GAS ARE HANDLED *Profitably* —

There is no simpler compressor unit than this to operate — and it may even be equipped for automatic operation so that scarcely any attention is necessary.



BY means of this economical compressor unit, enough gas may be sold from a small well to pay back the investment in six months. Earnings from then on may be clear profit — minus a small amount for operation and maintenance.

Type G-MG is a 2-cycle, direct driven unit rated at 50 H.P. All parts of this unit except the main frame are interchangeable with corresponding parts of the G-AG oil field pumping engine. A larger unit designated as Type G-MO is rated 70 H.P. as a direct connected compressor unit. These units have been designed especially to handle small quantities of gas from individual wells or from small groups of low producing wells. Write today for bulletins.

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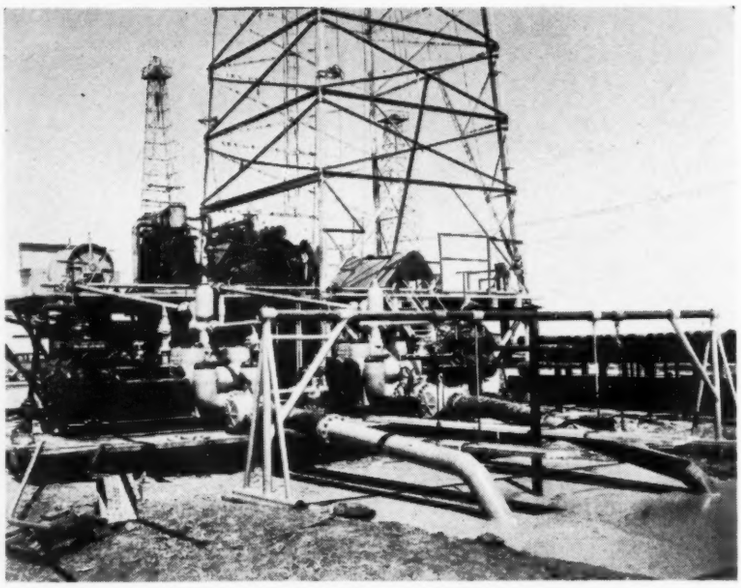
Slush Pumps For Rotary Drilling



Two super (15-in. x 7¾-in. x 20-in.) steam slush pumps on a Gulf Coast well. Note the combination-suction fluid ends, the suction strainers, and the suction hoses

WITHOUT question, the slush pump is one of the most important pieces of equipment used on a rotary drilling rig. Upon its efficient and continuous operation depends the amount of hole drilled per unit of time. The footage per bit also depends on the slush pump, as the bit must be kept clean to maintain its cutting efficiency. The condition of the walls of the hole and the proper removal of the cuttings released by the bit from the formation are determined by the ability of the slush pump to handle abrasive fluids of a wide range of viscosities and specific gravities over a wide range of discharge pressures. Upon the slush pump rests the responsibility of preventing expensive blow-outs when a gas-bearing formation is being drilled and when heavy mud is used to hold back the formation pressure. In fact, the slush pump determines in a large measure the success of all rotary drilling operations; therefore the operator, to be successful, must give very thorough consideration to the slush pump he will use.

Practically all slush pumps now in use are of the duplex double-acting piston type. This type provides for the greatest capacity per pound of weight and is most portable. Its discharge flow characteristics are very satisfactory, and it is well adapted to withstand high working pressures. One or two other types of pumps have been tried as slush pumps, notably centrifugal and outside-packed plunger, but up to the present the piston type remains supreme by a wide margin.

The size and type of slush pump to be used should be determined by the size of the drill pipe, the size and depth of the hole to be drilled, the type of tool joints used, particularly with respect to the size of the fluid opening through the joint, the probable formation pressure to be encountered, and the type of power available. Where the bit drills a hole twelve inches or smaller, the pump, for best results, should have pistons approximately 7¼ in. in diameter and be of 18-in. stroke. A duplex double-acting piston pump of this size has a displacement of approximately 2800 cu. in. per revolution, equal to 12 gal. per revolution or 600 gal. per minute at 50 r.p.m., which is a satisfactory normal speed for average operating conditions. For holes larger than 12 in. a satisfactory fluid end size is 7¾ in. by 20 in., which has a displacement of approximately 750 gal. per minute at 50 r.p.m. The most effective fluid volume is that which keeps the bit clean, emerges from the bit at high velocity, and returns to the surface with sufficient velocity to carry the formation cuttings with it. For relatively small holes, pump sizes smaller than those mentioned above are, of course, equally satisfactory.

The discharge pressure against which the slush pump must operate is determined entirely by the fluid friction in the system. By far the largest percentage of the friction loss is encountered in the drill pipe and its tool joints in deep drilling. The rather recently developed full hole or stream line tool joints and internal flush joint drill pipe have considerably reduced this friction loss, and have resulted in lower slush pump discharge pressures than were previously encountered except, of course, where drilling under pressure is resorted to, in which case the controlling factor is quite likely to be the fluid pressure required in the hole to hold back the formation pressure. Under normal drilling conditions the average discharge pressures are as follows:

Fluid End Size	*R.P.M.*	*Drill Pipe Size*	*Depth*	*Discharge Pressure*
7¼ x 18	50	6-in.	4000 ft.	450 lb. per sq. in.
7¼ x 18	50	6-in.	6000 ft.	700 lb. per sq. in.
7¾ x 20	50	6-in.	4000 ft.	600 lb. per sq. in.
7¾ x 20	50	6-in.	6000 ft.	800 lb. per sq. in.

These pressures are for relatively low viscosity mud. When especially high fluid pressures are encountered, it becomes necessary to reduce the piston diameter and install correspondingly smaller liners in the pump or to resort to the operation of two pumps compounded or in series, in which case the final discharge pressure is reached in two stages. It is almost universally customary to have two slush pumps on a drilling rig at all times, one of them to act as stand-by.

The power means by which the fluid pistons are to be motivated is determined by local conditions. The more common means is to attach to the fluid end of the pump, a direct-acting duplex double-acting steam end, the steam piston rods being joined directly to the fluid piston rods by crossheads and the steam end casting fitted with a cradle or tie piece by which it is attached to the fluid end casting and within which the crossheads operate. This type of pump, since it cannot use the steam expansively, is relatively uneconomical in consumption of steam—hence it requires considerable boiler capacity. To offset its inefficient use of steam, it has simplicity of construction, light weight, and low initial cost. Where utmost economy from the steam generated is desired, or where only electricity or internal combustion engine power is available, the fluid end piston rods of the pump end are attached to the crossheads of a duplex crank type power end. In locations where water is bad and scarce and fuel is costly, but steam is used for drilling, twin steam engines equipped with hand adjustable cut-off control, which

(Continued on Page 44)

PRESSURE

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provides for using the steam expansively, thereby effecting pronounced steam economy, have been used very successfully for driving power slush pumps. Where electric power is used, separate electric motors drive the power slush pumps, and where internal combustion engines are used, a mechanical transmission from the engines is used to drive the power slush pumps.

For high fluid discharge pressures, it is customary to use liners and pistons of smaller diameter, which, of course, reduce fluid volume. Where this reduction in fluid volume is objectionable, two slush pumps are compounded or operated in series, by which means the full capacity of one pump is obtained, and each of the two pumps operates at one-half the total discharge pressure. The compounding of steam pumps is a very simple matter, since the tendency of either pump to operate at a faster or a slower speed than the other pump is immediately compensated for by a change in load on the respective pumps, and causes them to divide the total load equally between them. The compounding of power pumps is somewhat more complicated, and the relative speed of the pumps must be controlled closely so that the total discharge pressure is divided equally between the two pumps. The point at which compounding must be resorted to depends on the steam pressure available in the case of steam pumps and on the capacity of the power ends and their prime movers in the case of power pumps.

STEAM END

The steam end of a direct-acting slush pump must be built for maximum efficiency, resistance to wear, and accessibility for repairs. The castings must be properly designed to withstand the maximum steam pressures available, which at the present time are 350 lb. per sq. inch.

For high steam pressures the piston type of steam valve is the only type that is satisfactory. This valve is of the outside admission type and is perfectly balanced, therefore exerting no more load on the valve gear for high-pressure steam than for low-pressure steam.

The steam valve should be operated within renewable bushings with milled ports, so that proper steam distribution and freedom from leakage will result. This type of steam valve is also well adapted to superheated steam with temperatures reaching a maximum of 600 deg. fahrenheit.

The valve gear must be rugged, well lubricated, and simple to keep in adjustment. The "inside slip" type of gear is universally used with the necessary lost motion being within the piston valve where the necessary points of contact between the valve stem and the piston valve are provided.

The cradles that connect the steam cylinders to the fluid end of the pump are preferably cast integral with the steam cylinder castings and must be very strong and rugged, but at the same time provide ample openings for access to the stuffing boxes of the steam and fluid piston rods and with sufficient space for the crosshead to operate. The design of the cradle is very important, since it must not only withstand the entire piston load but also must firmly join the steam end to the fluid end in such fashion that when the pump is transported there will be no danger of breaking the cradle.

The steam end must be designed so that the pump will make its normal stroke over a wide range of speeds and pressures, but at the same time the steam pistons must be cushioned properly to avoid their striking the heads of the steam cylinder over a wide range of conditions. In order to accomplish this cushioning, the steam cylinder is of the double-ported type, in which the piston closes the exhaust port slightly before reaching the end of its normal stroke, thereby trapping steam ahead of it in the clearance space, and, being compressed by the energy of the reciprocating parts, forms the necessary cushion. It will be seen, therefore, that the contact stroke must be slightly longer than the normal stroke.

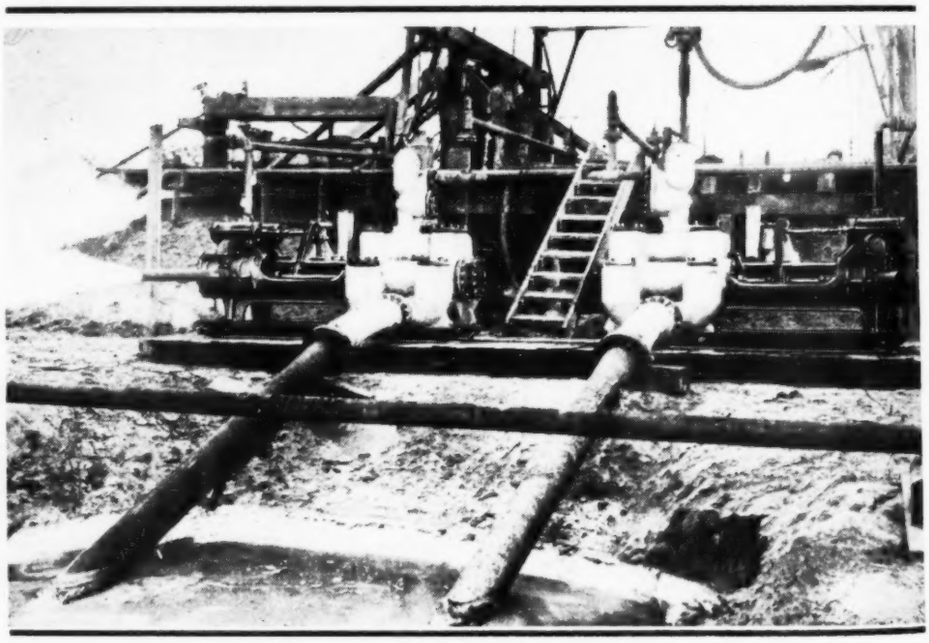
The amount by which the contact stroke exceeds the normal stroke must not be excessive if the pump is to operate economically, as additional clearance space is very detrimental from the standpoint of steam consumption.

For steam cylinders 14 in. in diameter and larger, a 4-in. steam inlet connection is considered desirable. A 4-in. exhaust connection is also commonly used on steam cylinders of the above sizes, which, theoretically, are somewhat too small but actually prove to be very practicable, since a larger size exhaust pipe becomes very cumbersome to handle in the field and, since at very high speeds of, say 60 r.p.m., it is necessary to build up an appreciable back pressure in the steam cylinders during the exhaust stroke so that proper cushioning results.

The average mean effective pressure in a well-designed steam slush pump steam end will be within 35 to 40 lb. of the pressure at the inlet with the pump running at speeds from 40 to 50 r.p.m.

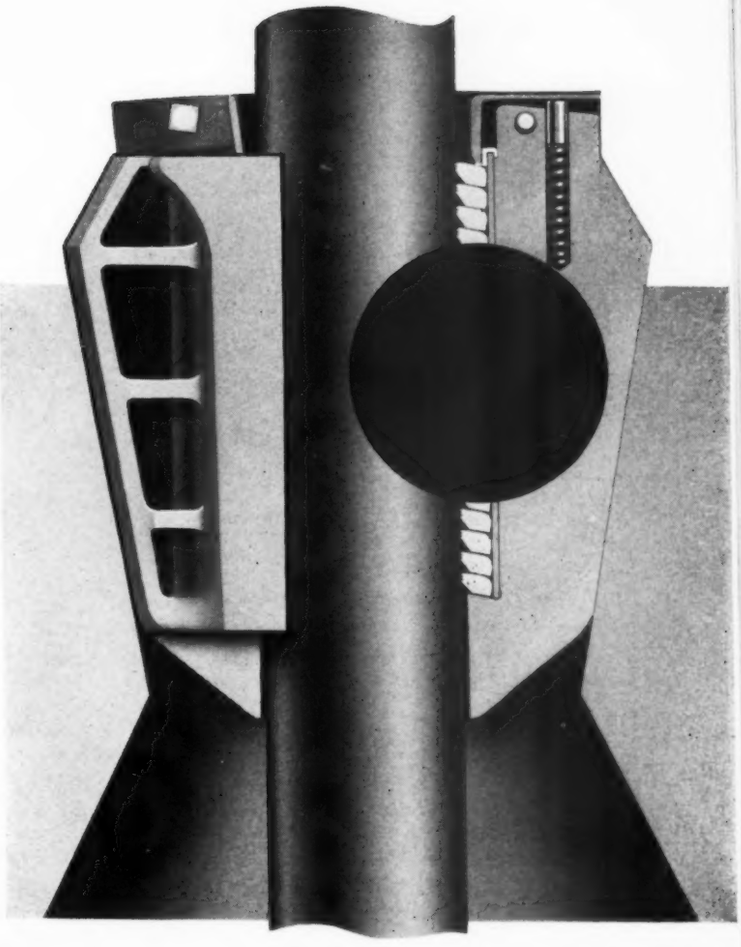
POWER END

Because of the fact that slush pumps must operate over a very wide range of pressures, the power ends of power slush pumps must be designed with ample overload capacity. The more efficient power pumps are now made of the twin side crank construction with the cranks set at 90 deg. and



Two (14-in. x 7¼-in. x 18-in.) steam slush pumps in service in an Oklahoma field that are equipped with side-suction fluid ends—suction lines can be connected directly to either side of the pump

The principle that brought



to MISSION SLIPS

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Note in the Illustration . . .

that the gripping mechanism consists of stacks of independently movable dogs. The rolling movement of the dogs from the pipe brings about . . .

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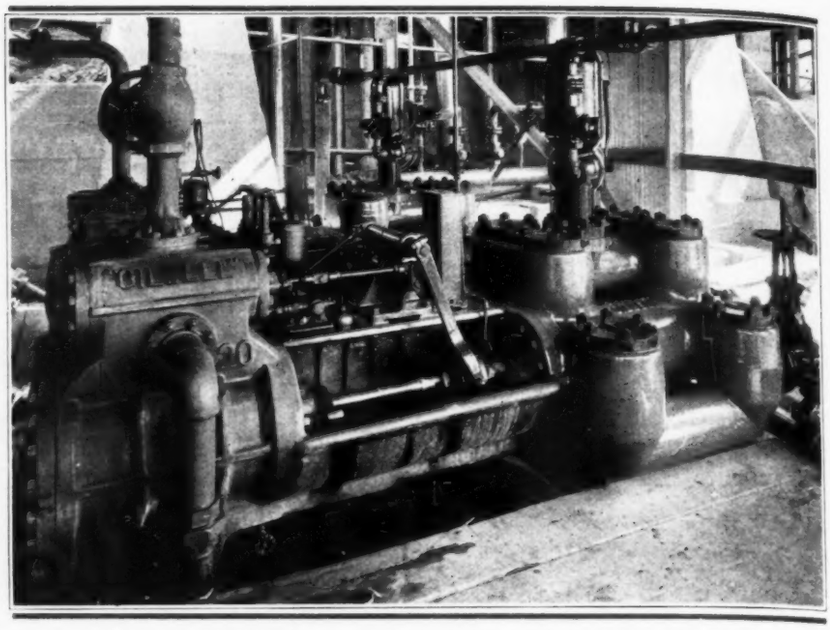

Two (15-in. x 7¾-in. x 20-in.) steam slush pumps beneath the derrick floor of a well in Kettleman Hills field, California

the crank shaft and crank pins equipped with tapered roller bearings. In order to arrange for a proper drive from the prime mover, it is the regular practice to incorporate in the power end a gear reduction, the pinion shaft of which is extended to receive a pulley drive from the prime mover, the pinion shaft also being mounted on tapered roller bearings.

The single helical type of gear is considered preferable for the reasons that it is quiet in operation, has overlapping teeth, and provides for properly adjusting the location of the pinion axially without any complications of bearing adjustment.

Since the crosshead guides in the frame of the power end are subject to rather severe loads and wear, it is the practice of some manufacturers to install renewable crosshead guides that can be replaced cheaply when worn and obviate the necessity of re-boring the power frame. The crossheads are of the box type, and the crosshead pin bearings are of excess capacity and designed to operate at a relatively low pressure per sq. in. under the normal loading of the power end.

It has been found preferable to make the crosshead pin end of the connecting rod of the solid eye type, using a pressed-in bushing as a bearing.

In order to exclude mud and water from the power end and to be able to use a relatively short fluid end piston rod when replacement is necessary, some manufacturers use a crosshead extension with an effective sealing device that prevents the water used to wash the slush pump rods from entering the power end. It is very essential that this device be effective, since water, if admitted, will seriously damage the bearings of the power end in a very short time.

It has also been found advisable to supplement splash lubrication of the parts in the power end with a multiple feed force-feed lubricator that delivers oil to each of the bearings individually. Since in many cases the power end of a slush pump is subjected to great overloads for long periods of time, the problem of lubrication is most important.

It is customary to construct the power end so that the pinion shaft extension may be shifted from one side of the pump to the other to provide for a right-hand or left-hand drive without disturbing any of the other parts in the pump. The use of the single helical type of gear permits this to be done very readily.

When the power end of a slush pump is designed, all the factors involved are taken into consideration, and the shaft sizes and bearing capacities are such that they will withstand the heavy service encountered while in actual field operation. The designer must rate the power end to carry a certain piston load at a certain maximum speed. The piston load is, of course determined by the area of the fluid piston multiplied by the discharge pressure and with a known rating of the pump the operator must reduce the piston size when the total load reaches that recommended by the manufacturer, making reasonable allowances, of course, for temporary overloads for which the pump must be designed if it is to be satisfactory for drilling.

Much difficulty with power slush pumps results from the fact that when they are driven by an electric motor that has a pull out torque factor of 3.5 to 4 above normal torque, the operator will not reduce piston sizes sufficiently soon to prevent damage to the power end of the pump.

FLUID END

The first question that occurs to the designer of the fluid end of a slush pump has to do with the material from which it is to be made. It has been proved very definitely that even the large size fluid ends (7¾-in.x20-in.) can be satisfactorily made from high-tensile cast iron that will be satisfactory for any operating pressures encountered thus far. It is common practice, therefore, to use high-tensile cast iron either with or without alloying metals and to test these fluid end castings hydrostatically from 3000 lb. to 4000 lb. per sq. in. which provides for a sufficient safety factor so that they may be operated continuously at from 1800 lb. to 2000 lb. per sq. inch. In order to reduce the weight to a minimum and to use the material most effectively for resisting internal pressure, the fluid end design must be of cylindrical section wherever possible. It should also be such that there are no internal walls in the casting that are subjected to high pressure on one side of the wall and low pressure on the other.

It is considered preferable to incorporate all the suction and discharge manifolds and passages in one integral casting rather than to make the two sides of the duplex pump and its suction pipe and discharge pipe separate, this latter construction entailing the use of many bolted and gasketed joints under high pressure.

All joints on the fluid end must be made of the hydraulic type that provides for a well-protected, narrow-faced gasket of suitable material to resist the pressures. The bolting for all openings must be of a high test material and the number of bolts reduced to a minimum consistent with the pressures encountered so that when inspection or repairs are necessary, all openings can be uncovered with facility. The suction and discharge passages throughout the entire fluid end must be ample in size, with long radius bends and of direct-flow type so as to decrease velocities and eliminate turbulence. There must be a total absence of air pockets below the discharge valve to prevent compression and re-expansion of air or gas entering the pump.

The liners must be readily removable and at the same time, effectively sealed at one end so that there may be no leakage whatsoever from one end of the pump chamber to the other. Some manufacturers provide an internal device for tightening the packing around the liner and seating the liner firmly and positively in the pump chamber. Others

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THE NATIONAL SUPPLY COMPANY

use a cylindrical type spacer that forces the liner into position by means of set screws extending through the fluid cylinder heads. With this construction the set screws protrude through the cylinder heads and should these not be properly tightened, leakage will result between the liner and the pump chamber and the pump chamber be damaged by the cutting action of the fluid that is by-passed.

One manufacturer has recently put on the market a special slush pump liner that is lined with a metal called "DI-HARD." This metal is thoroughly bonded to the liner shell and has a hardness of 600 to 650 Brinell. It also has a very low coefficient of friction, and these characteristics result in very much improved wear life of both liners and pistons.

A few years ago the swab rubber type of piston was in general use in slush pump service. It consisted of a piston body with a separate follower and a plain cylindrical rubber ring compressed between the piston body and the follower. In recent years it has been definitely proved that the slush pump piston should be made of such a type that as the piston travels in its stroke, rubber material should contact the fluid first instead of metal and that, furthermore, a much more effective piston seal can be obtained by making the rubber covered ends of the piston of such shape that they are slightly compressed when entered into the liner, the effect of the pressure against them being such that they will make a complete seal with the inside of the liner during the discharge stroke. There are several pistons of this type on the market, some of them having the rubber vulcanized to the piston body, a construction that necessitates discarding the entire body when the rubber becomes worn. Others are made with separate rubber rings that are renewable when worn without discarding the piston body.

Experience indicates that a slush pump valve, to be effective, must have a combination metal and rubber seating surface. The metal must be provided of ample dimensions in order to resist the hammering action of the valve on the seat, and the rubber must be provided in conjunction with the metal surface to form the necessary seal.

There are several valves of different manufacture all incorporating this same principle. One manufacturer has provided a valve that is symmetrical about both of its axes, thereby permitting the valve to be reversed when one side is worn, thus providing for a new seating surface and doubling the life of the valve.

Valves and seats in slush pump service must be made of alloy heat-treated steel to be most effective and to resist the abrasive action of the mud fluid effectively. The net valve area is also an important factor in the efficiency of the pump. There are certain structural limitations in designing a slush pump that prevent building into a pump the maximum desirable valve area, but it is a definite fact that the greater the net valve area, the greater the volumetric efficiency of the pump. This is particularly true in a slush pump where the fluids are not only abrasive and, therefore, should be handled at low velocity, but they are also very viscous.

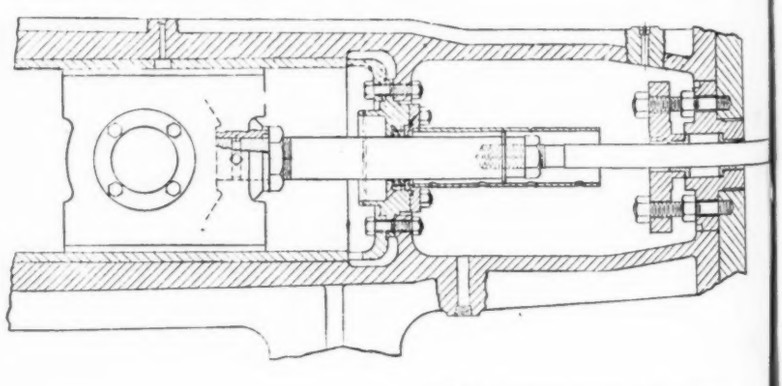
The size of the suction connection and the suction passages to the suction valves will determine largely the operating efficiency of the pump. Such a connection for pumps having pistons 7¼-in.x18-in. stroke and larger should be 10-in. in order to reduce the velocity of the fluid in the suction line as much as possible when the pump is running at high speed. The size of the discharge connection is not so important except that the smaller its size, the greater will be the pressure loss between the fluid piston and the string of drill pipe. Although 3-in. discharge manifold connections and stand pipes have been used quite generally in the past, many operators are now making the manifold and stand pipe of 4-in. size, and the larger slush pumps should be equipped with 4-in. discharge connections.

One manufacturer has had on the market for some time a fluid end with what is called a combination suction arrangement. Up to a short time ago all slush pumps were equipped with an end suction connection only. In view of the fact that certain operators wish to place their pumps parallel to the slush pit, and others wish to place them with the fluid end toward the slush pit, this manufacturer has standardized on the combination suction type, particularly for steam slush pumps, whereby a full 10-in. suction connection is provided on both sides of the fluid end as well as at the outer end of the casting so that the operator may follow his own choice as to the placing of the pump and, at the same time, eliminate in any case all unnecessary elbows and turns in the suction line. The combination suction arrangement is also of considerable advantage when it is desired to compound with another pump as one of the blind flanges covering the suction opening not in use can be readily provided with an opening to receive the discharge pipe from the lower stage pump of the compound set-up. This makes a very effective arrangement and eliminates fittings and valves.

The suction line to a slush pump should receive the most careful consideration of the operator. It must be absolutely air-tight at all times and yet be flexible enough that its outer end may be lifted from the bottom of the pit in order to remove debris that may have collected there. It is now quite common practice to install a 4- or 5-ft. length of suction hose close to the inlet of the pump. This hose provides sufficient flexibility so that the outer end of the suction line may be lifted from the pit; at the same time it absorbs considerable of the hydraulic shocks that are present in the suction line. It does away with any need for swinging joints or packed stuffing boxes and is most effective in obtaining satisfactory slush pump operation.

One manufacturer has developed a very effective type of suction strainer, which is attached directly to the suction connection of the pump. This strainer is equipped with a screen of ample area, being several times the area of the suction pipe itself, and the screen, being attached to a cover, is readily removable for cleaning. The design of the strainer is such that no air pockets exist that would interfere with satisfactory pump operation, and the flow of the fluid in all cases is such that the debris collected by the strainer is deposited on the inside of the screen and is, therefore, removed with the screen when it is being cleaned.

Since upon the efficient operation of the slush pump will depend largely the success of the rotary drilling operator, the choice of the pump and the provision of the very best operating conditions after installation should have his most serious consideration.



Special piston rod and assembly that prevents mud and grit from reaching the crosshead and permits the use of a shorter fluid piston rod of smaller diameter

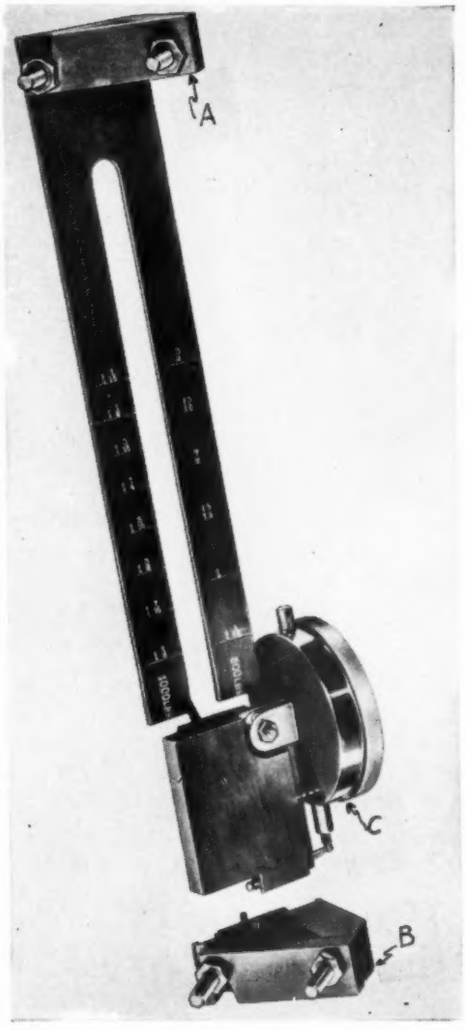


Fig. 1. Wellometer taken apart showing: *A*. Stationary V-block. *B*. Movable V-block clamp. *C*. Amplifying dial instrument assembly.

A Simplified Well Dynamometer . . . Its Uses and Limitations

By J. C. SLONNEGER
Engineer, The Falk Corporation,
Milwaukee, Wisconsin

THE specific purpose of measuring the polished-rod load or the rod-line pull of an oil well should dictate the design of the instruments to be used.

For scientific research under the supervision of a competent engineer, the instruments used should be quite scientifically accurate, accompanied by all the necessary 'gadgets' to make them so. For everyday use, however, the instrument should be simplified as far as possible, and its operation made quick and convenient. Heretofore designers have not recognized the need of a well-weighing instrument for everyday use with the result that the weighing of an oil well was restricted to the supervision of technical men, and the actual operator of the well was left without means of ascertaining the condition of the subsurface equipment, other than the feel of the polished rod.

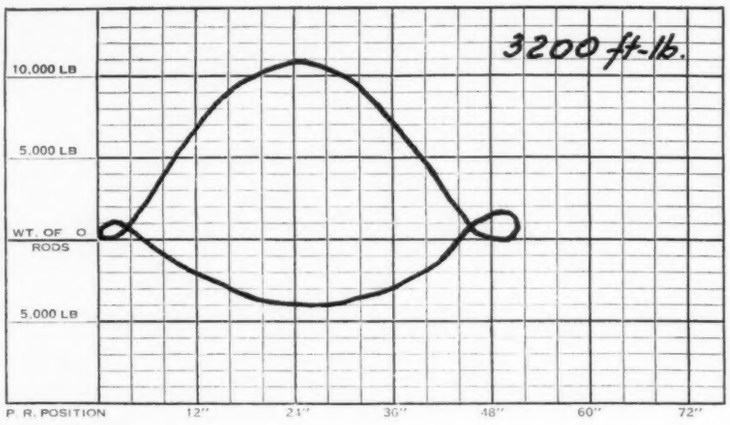
In passing, let us remark that many operators developed a feel that is almost uncanny. There has long been a need for some instrument that would register the variations in the polished-rod or rod-line load that could be applied quickly by non-technical men. Much, no doubt, has been lost for want of such an instrument.

A recent design of a simplified dynamometer, known as the Falk Wellometer, aims to meet these everyday requirements.

The principle of operation upon which it is designed has long been known; it being that of a telemeter. A measured portion of the rod upon which the load is to be determined is gripped by clamps and the change in length of that measured portion is magnified and indicated on a dial instrument. The relationship of the measured length to the diameter of the rod and to the degree of magnification is such that the dial instrument indicates pull in pounds directly, avoiding the calculations necessary to transfer stretch to pull. This relationship is predicated on a value of 29,000,000 lb. per sq. in. for Young's Modulus of Elasticity. A simple way to explain the principle of this new instrument is to say that it is a spring scale wherein a measured portion of the rod itself becomes the spring of the weighing scale.

In the design of the instrument it is recognized that rods are not always subjected to straight pulls but are bent in some plane. To attempt to make an instrument immune to bending in all planes would be to lose its simplicity and perhaps a great deal of its accuracy. Since polished rods bend in the plane of the walking beam and rod lines bend in the plane of gravity, it was deemed sufficient to make the instrument immune to bending in only one plane and then attach it to the rod so that this immune plane would fall in the plane of bending of the rod.

Fig. 2. Wellometer attached to polished rod ready for operation.



WELLOMETER DATA CARD

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OWNER Ex Oil Co.

LEASE Smith WELL NO. 2

DEPTH 3250 ft. TUBING 3"

PUMP SPACING 3200 ft. ANCHORED No

PUMP Common 6 Cup

PLUNGER SIZE 2 3/4" CONSTANT 880

ROD LINE — STROKE —

COUNTER BALANCE Rotary – 8000#

RODS

SIZE	LENGTH	WEIGHT
7/8"	1400	3150
3/4"	1800	3050
TOTAL	3200	6200

P. R. STROKE 50 INCHES S. P. M. 26

BBL / HR. ACTUAL 48 CAL. 47.7

EFFICIENCY 100.1 %

Fig. 3. Card plotted from Wellometer readings taken during the pumping cycle. Data shown on the right are on reverse side of card.

Fig. 1 shows the three important parts of a Wellometer disassembled. They are (1) a stationary V-block clamp *A*, provided with a graduated blade for selecting the proper measured portion of the rod according to the rod diameter; (2) a movable V-block clamp *B*, to be set to the proper graduation; and (3) an amplifying dial instrument assembly *C*, Fig. 2 shows the assembled instrument attached to a rod ready for operation.

The technique of operation is quite simple. After the movable V-block clamp has been set to the proper graduation, the instrument is clamped to the rod so that the plane of the graduated blade lies in the plane of the bending of the rod, that plane being immune in the instrument. Specifically in the case of a beam well, the plane of the graduated blade is set in the plane of the walking beam, and in the case of a rod line it is set in a vertical plane. The dial instrument assembly is adjusted and clamped to bring the indicating hand to any convenient position. The card of the dial may be rotated to bring it into any initial reading for static load.

It has been found sufficiently accurate to compute the static load. That is to say, the static load may be taken as the weight imposed by the rod string in the well, which is known.

It has also been found exceedingly useful to set the static load at zero and read the instrument plus and minus, later on adding the static load to the readings. The reason for this is that it presents a better mental picture to the observer as to the happenings in the well, how the fluid is being lifted, and how the rods are falling. This information appears to be the most vital to be procured in a pumping well. Any change in the pumping conditions will affect the instrument readings.

With a little practice, a card may be plotted showing the cycle of pumping from which the ft-lb. of work done per stroke may be easily and quickly determined. Such a card is shown in Fig. 3. With the daily use of this instrument one soon comes to recognize certain pumping cycle peculiarities, such as pounding fluid, striking bottom, sticking plungers, etc. The condition of the valves and plunger, and when the well needs servicing, can also be determined. The "feel" of this instrument is far more delicate than the human touch in spacing rods.

After a well has been serviced and the pump replaced, the instrument attached to the polished rod will indicate quite quickly how well the pump is functioning by the increase in load as the fluid is raised in the tubing, thus avoiding unnecessary loss of time.

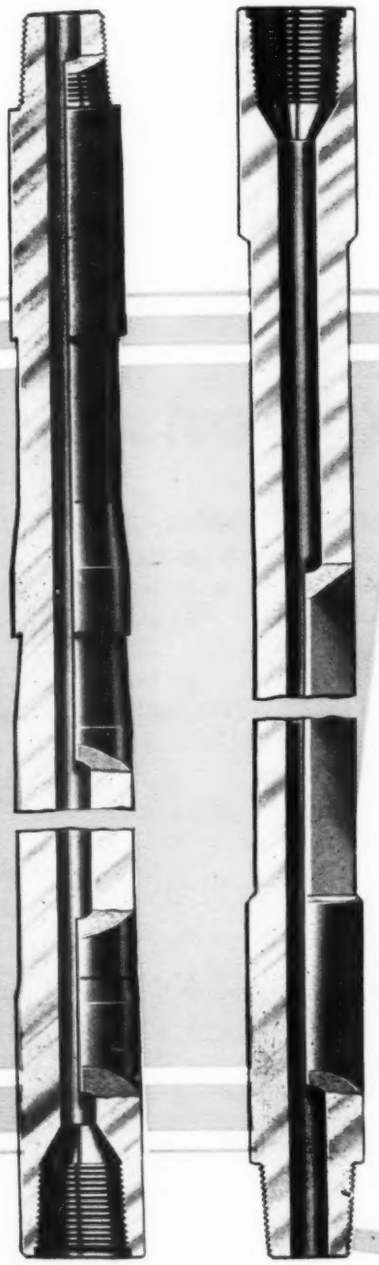
A central power may be brought into good balance by the information gained in weighing the rod lines. The conditions of the distant wells will be indicated in the dial reading. Each well about a central power may have its own peculiar pumping cycle, yet any change in any one of the wells will be quickly recognized if the Wellometer is in daily use.

The advantages of this instrument lie primarily in its simplicity and in the fact that it may be applied very quickly. The well need not be shut down more than three minutes to attach or remove; thus it is adapted to daily use and under proper conditions it is quite as accurate as it needs be for its purpose, namely: to assist in improving the operation of a pumping well.

Manifestly the instrument must have limitations. Those limitations are imposed by the rod to which it is attached. To give accurate results the rod must be straight and sound. The bending must be in the immune plane only. A kinked rod, a badly misaligned walking beam, or a poorly balanced rod hanger, wherein a much greater pull may come on one side member than on the other produces distorted readings. Fortunately, these distorted readings are quickly recognized as such and fool no one. These defects in equipment should be corrected whether or not a reading is to be taken with the Wellometer. It goes without saying that the best subsurface results cannot be obtained with poorly designed and installed surface equipment.

EMSCO

Straight hole DRILL COLLARS and DRILL STEMS



Emsco Forged Upset Drill Collar with Elevator and Overshot Recess

Emsco Forged Upset Drill Stem

Emsco Straight Hole Drill Collars and Drill Stems, with unobstructed fluid passage and uniform wall thickness, withstand the severe service of modern deep well drilling.

Recently installed equipment of the latest type for the manufacture of these products assures operators of the highest precision and quality.

Supplied in either carbon or nickel steel, with plain or heat-treated ends, in all diameters and lengths. Also available with full length heat treatment for the elimination of stresses and for producing balanced physicals; resulting in greater strength and ductility, and reducing fatigue to minimum.

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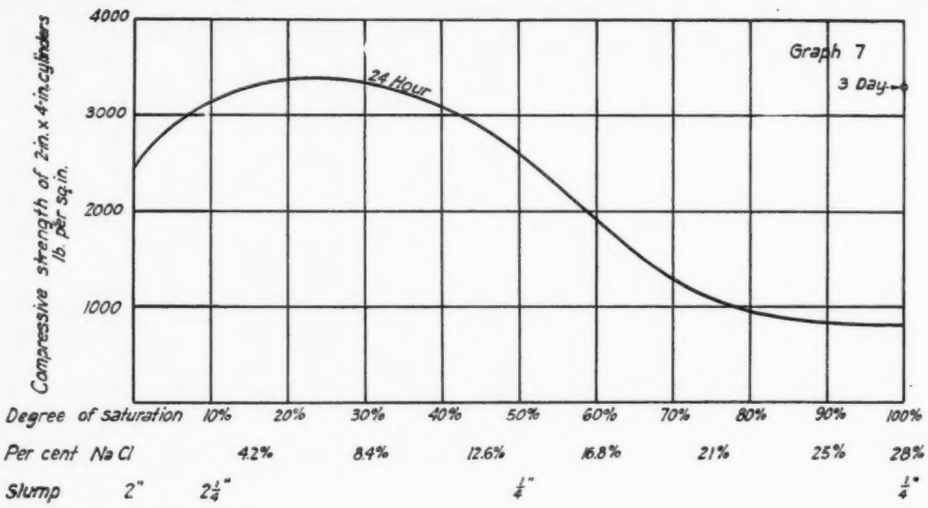
Graph 7
Compressive strength of 2 in. x 4 in. cylinders lb. per sq. in.
4000
3000
2000
1000
24 Hour
3 Day
Degree of saturation 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Per cent Na Cl 4.2% 8.4% 12.6% 16.8% 21% 25% 28%
Slump 2" 2¼" ¼" ¼"

Fig. 7

By
S. L. MEYERS

Chief Chemist, Southwestern Portland Cement Company, El Paso, Texas

Part 2

Behavior of Cement Grouts Under Oil Well Conditions

Effect of Impurities in Mixing Water

IN making concrete, only water fit to drink is recommended for mixing; in spite of this, very contaminated waters have been used without greatly lowering the strength of the resulting concrete. In neat cement of a fluid consistency, impurities in the water will have greater effect than in the case of structural concrete using lesser amounts of water; still it appears doubtful if a well water ever contains sufficient detrimental impurities to be the sole cause of cement failure.

The effect of varying amounts of salt on the 24-hour compressive strength is shown in Graph No. 7 (Fig. 7). Between 20 percent and 30 percent saturation, salt appears to have a beneficial effect; between 70 percent and 100 percent saturation the strength is lowered considerably. The 28-day tests do not appear on chart, but at this period there is less difference in strength due to different concentrations of salt, indicating that the ultimate strength will not be harmed much at any concentration of salt.

Expansion and Contraction

In order to aid bonding between well wall and cement, and casing and cement, it appears desirable for hardening grout to expand to some extent. If shrinkage occurs and bond is broken not only is mechanical strength lessened but resistance to water passage is also decreased.

Fortunately all portland cements expand in water and the need of expansion is greatest where water is present.

The rates of expansion in water and contraction in air is illustrated in Graph No. 8 (Fig. 8). This is another property that, along with strength and permeability, is affected by the use of low percentages of mixing water.

Mud Contamination—Serious Effect

It is probable that mud contamination occurs to a slight

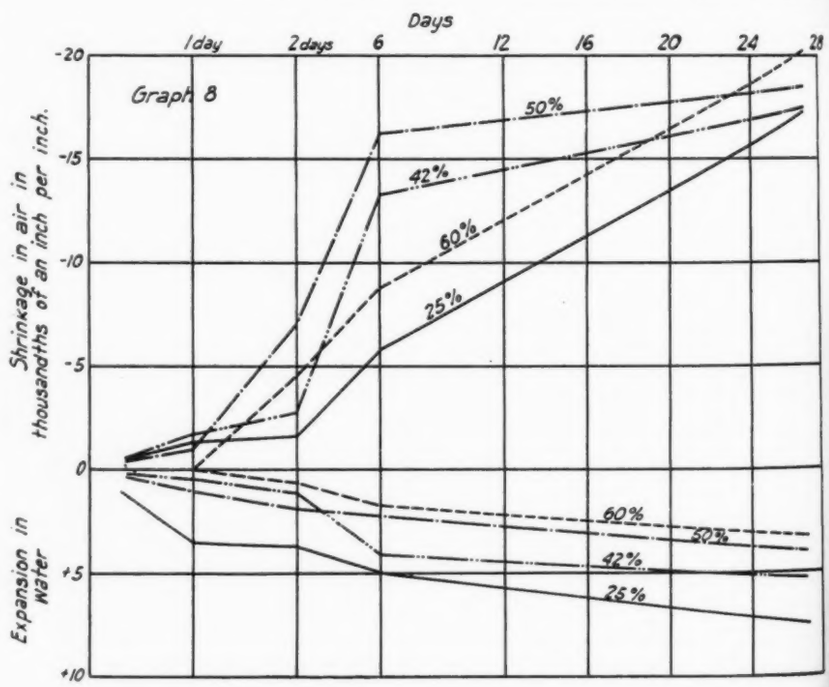

Fig. 8

LET YOUR WORST SULPHIDE WELL PROVE "OILWELL" GRADE "S" SUPERIORITY

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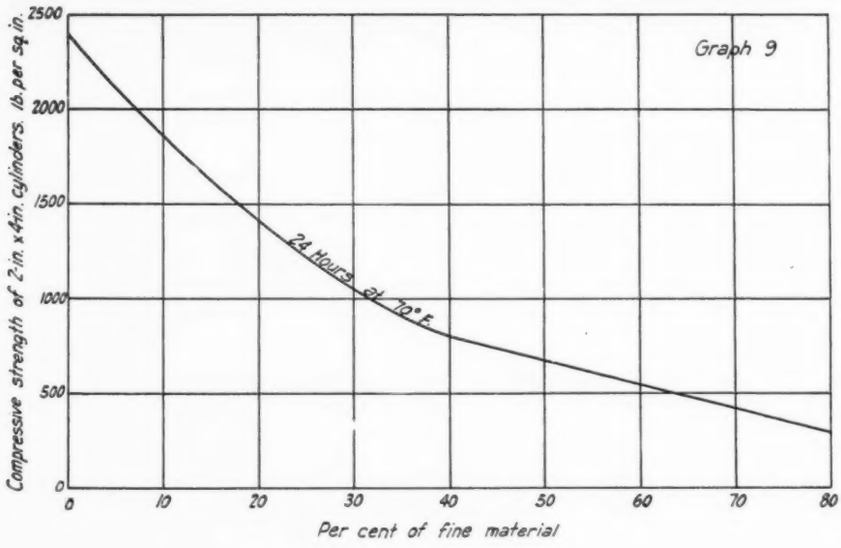


Fig. 9

extent even under the most favorable cementing conditions, but in these favorable conditions it does little harm, since it mixes in with the advancing cement fluid and is pushed to the top of the cement column. In other cases where the circulating mud has been too thick, or where the casing is not concentric with hole, channeling of cement up through the mud can occur leaving the mud in place through which water can flow.

Graph No. 9 (Fig. 9) shows the effect of displacing cement with dry, powdered mud on 24-hour compressive strength.

Effect of Agitating Grout

If the hydrostatic head on the cement column placed between earth wall and casing is not so great as the gas or fluid, or the pressure behind or below the earth wall, the outside pressure will tend to escape through the cement column and in so doing will agitate the cement and keep it from setting. If this agitation continues long enough only a bulky, colloidal hydrated mass of cement will result that will be incapable of setting up or developing any strength. This condition appears to be a major cause of cement failures.

Graph No. 10 (Fig. 10) shows the effect up to one day of agitation on setting times. All tests date from the time agitation stops.

Suitability of a Cement for Oil Wells

A single oil well cement cannot be ideal for all fields or all well conditions. In some fields slow-setting cements may be desirable; in others quick-setting cements. In some permeability may be of primary consideration and in others strength, etc.

Portland cement is made by finely grinding, intimately mixing, and correctly proportioning a basic material, limestone, with an acid material, like clay, shale, or slag; burning this mixture at close to 2800 deg. fahr., and grinding the resulting clinker with gypsum to form cement. During the burning, lime combines in various ways with silica, alumina, and iron, to form the clinker minerals.

In Table 2 symbols are used to designate the clinker minerals.

The properties of a cement are the resultant of the properties, and the amounts present, of the different compounds making up the cement. For eight different properties that affect the performance of cement in a well, the four major compounds are arranged in their effective order.

Low water requirement cements, rapid-hardening cements, slow-hardening cements, sulphate-resisting cements, and temperature-resisting cements, are all possible by selection of the right proportion of the different cement minerals.

TABLE 2

Order in which the four main clinker compounds affect cement properties.

ABBREVIATIONS

C_4AF—Tetracalcium alumino ferrite C_2S —Dicalcium silicate
C_3A —Tricalcium aluminate C_3S —Tricalcium silicate

Strength of hardened neat grouts earlier than 28 days	C_3S	C_3A	C_4AF	C_2S
Setting times, or initial stiffening of grouts	C_3A	C_3S	C_4AF[1]	C_2S
Fluidity of grout at constant W/C	C_3S	C_4AF	C_2S	C_3A
Temperature rise of grout while mixing	C_3A	C_3S	C_4AF[1]	C_2S
Resistance to accelerating effects of high temperatures	C_4AF	C_2S	C_3S	C_3A
Resistance to Sulphate solutions[2]	C_4AF	C_2S	about equal C_3S	C_3A
Resistance to permeability[3]	C_3A	C_3S	C_4AF	C_2S
Volume changes of hardened grout, due to moisture changes	C_3A	C_3S	about equal C_2S	C_4AF

[1]C_4AF is itself quick setting but the absorption of C_3A in C_4AF results in a net slowing of set.
[1]This also applies to temperature rise of grouts.
[2]From Portland Cement Association fellowship Paper No. 28.
[3]Data too meager to be reliable.

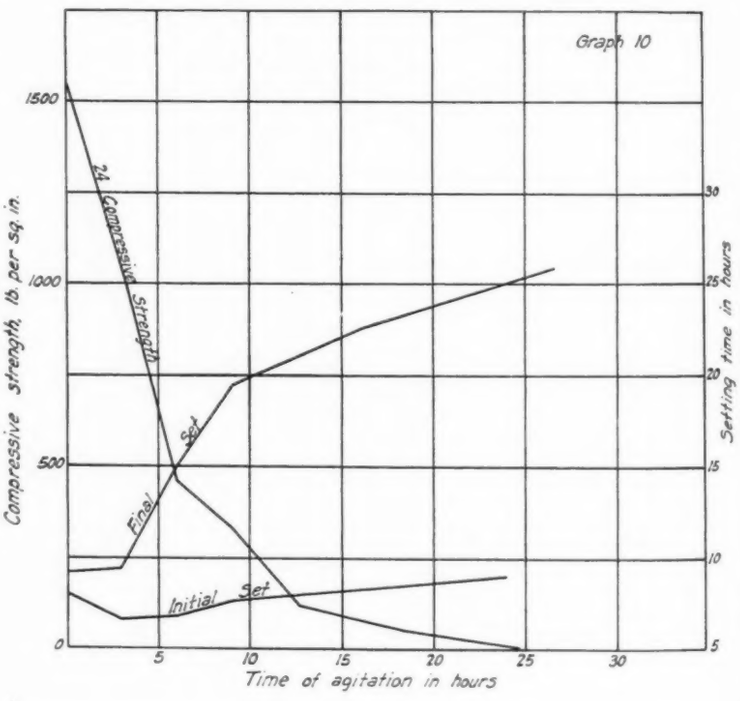


Fig. 10

Flagging the Relief Valve

By ELTON STERRETT

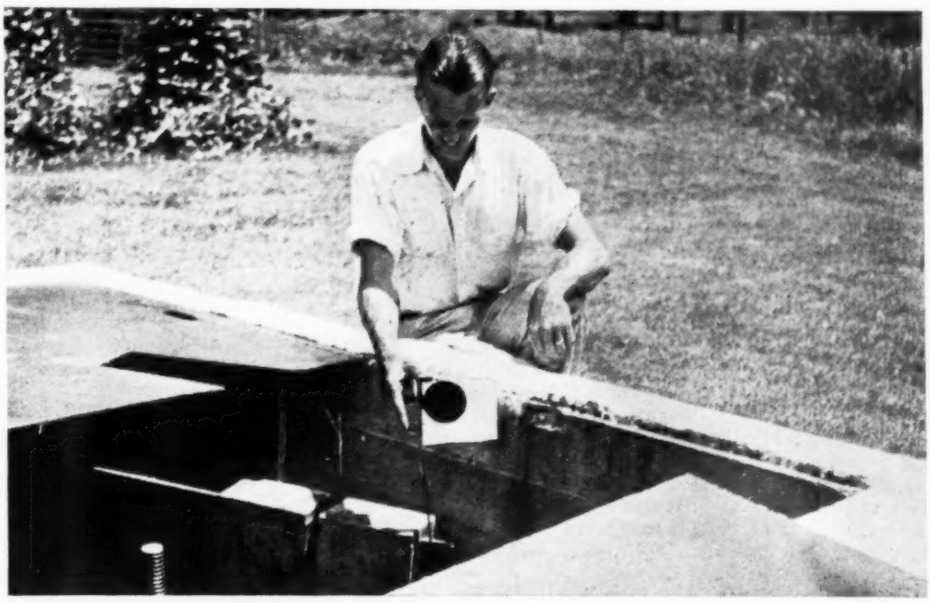
THE main line relief valve at many pumping stations, being at a point beyond the last tie-in from any station unit, is often so far from the office that some check other than one requiring an on-the-spot inspection must be provided. Especially is this true when—as is generally the case—the line is being worked right up to its maximum allowable pressure.

In such a case, with the relief carefully calibrated to operate at the least over-pressure, there is a chance that the mechanism will function under excess pressure and bleed back just enough of the oil being pumped to prevent the recording and other station gauges from showing the pressure increase; that is, with the excess pressure being relieved at the valve, there will be nothing other than a quickly flooded sump pit to warn the engineer that he is attempting to put through more oil than can be carried at the prescribed pressure.

One shift engineer rigged up a flag on the relief valve counterweight arm so that with motion upward sufficient to crack the valve, the flag—composed of a rectangle of board painted white and supported on a riser from the weights—would precede the arm through the clearance slot in the pit covers and thus indicate the beginning of a lift of the valve.

This scheme worked perfectly for the "day" men, but the white flag failed to contrast with the whitewashed pit walls at night, so the "graveyard" man got a red bicycle "tail-light" or reflector, and adjusted it on the flag so that in a raised position it would intercept rays from a near-by yard light and reflect red toward the office window.

Thus improved, the flag became 24-hour perfect, and has saved the station many a flooded sump by giving prompt warning of the beginning of an upward swing of the relief valve counterweight arm.



24-hour visible signal on counterweight arm of main line relief valve. In the view the valve has begun to lift, though as yet no oil has been by-passed, nor do the gauges in the station register any pressure increase above allowable

Bureau of Mines to Conduct Petroleum and Natural Gas Research at Amarillo, Texas

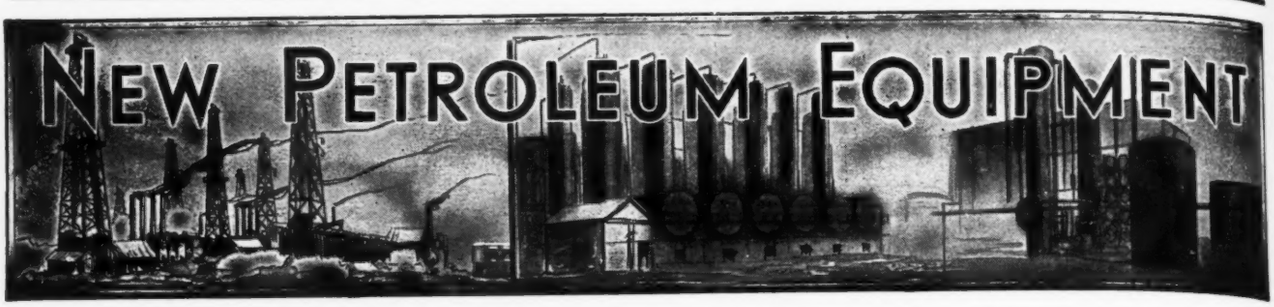
Plans for future activities of the research laboratory at the Amarillo, Texas, helium plant have been announced by John W. Finch, director of the Bureau of Mines, Department of the Interior. The laboratory staff, which in the past has been concerned largely with work relating to production and conservation of helium, will now direct its efforts toward studies of technical problems involved in production and utilization of petroleum and natural gas. The Amarillo laboratory is one of the best equipped in the country for research on properties of gases at low temperatures, and additional facilities will be provided for the petroleum studies now being initiated.

The Bureau of Mines has been conducting research studies dealing with oil and natural gas through its Petroleum Experiment Station at Bartlesville, Oklahoma, and field offices at Dallas, Texas, and San Francisco, California. These include engineering and chemical studies relating to production, transportation, and refining of petroleum, natural gas and their products. Such work is being broadened with initiation of petroleum research at the Amarillo laboratory and the reopening of an experiment station at Laramie, Wyoming, which will deal with problems in refining and production in the Rocky Mountain area.

In the Bureau's studies relating to oil production emphasis is being laid on the energy associated with petroleum fluids in their natural reservoirs, or producing formations, and the efficient utilization of that energy in obtaining the maximum recovery. The laboratory at Amarillo will take part in that phase of the Bureau's research by making studies of physical and thermal properties of petroleum mixtures that have influence on their flow through the producing sands and in wells, using specialized experience and technique developed in the research that has done so much to improve methods and reduce costs of extracting helium from natural gas.

The laboratory at Amarillo and field studies conducted from it will be especially beneficial to oil operators in the Texas Panhandle, West Texas, and New Mexico districts.

The petroleum research activities at Amarillo, as well as the continued operation of the Government-owned helium plant and 50,000 acres of natural gas properties, will be under the general direction of R. A. Cattell, chief engineer of the Bureau's Petroleum and Natural Gas Division, Washington, D. C. W. Seibel, supervising engineer of the helium plant, will be in administrative charge at Amarillo, and several petroleum technicians will be added to this staff to aid in the petroleum research centered there.



General Duty Welding Torch

A NEW welding torch known as the Purox No. 35 General Duty Welding Torch has been announced by The Linde Air Products Company, 30 East 42nd Street, New York. In mechanical details this new piece of equipment embodies many refinements in design and operation. Constructed of extruded brass, Monel metal, and drawn copper, and with silver-soldered tubes, this torch is rugged and can stand rough treatment, the manufacturers state. Its range of usefulness makes it equally adaptable to the lightest as well as the heaviest work to be found in any welding shop. It is listed by Underwriters' Laboratories, Inc.

There are many important features. The ribbed design of the extruded brass handle reinforces the torch and enables it to be easily gripped. The connections are ferrule type and extend parallel to the axis of the handle. The individual mixers in each welding head are so designed that maximum resistance to flashback is afforded and at the same time the effective range of each size tip is greatly increased. Nine tips perform the duty of 15, the number usually required. The Monel-metal seating surfaces are protected, wear-resistant, and easily removable for cleaning or replacement.

A hexagonal socket arrangement permits the welding head to be assembled in the most convenient of six optional positions in relation to the body. This arrangement also prevents injury or scoring of the seating surfaces.

The tips are of hard-drawn copper. They are of the right weight to withstand excessive heat and to maintain perfect balance in the torch as a whole.

The standard Purox No 21 Cutting Attachment can be used with the new No. 35 torch. The latter is transformed into a light-duty cutting torch having an unusual efficiency of performance given by the new design features of the torch itself.

A. O. Smith "High-Yield" Casing

THE A. O. Smith Corporation of Milwaukee, Wisconsin, has announced that it is now ready to supply the new "High-Yield" Casing, of which considerable has been heard recently. Production has begun on 6⅝-in. and larger sizes. The casing will be made to A.P.I. standard dimensions.

In the opening announcement, the company states that the product, which is cold worked during manufacture, will have an exceptionally high yield point, making it better able to resist collapsing pressures.

The process by which High-Yield Casing is made is patented and said to be an entirely new departure in this form of metal working. The compression yield strength has been raised to approach closely the ultimate tensile strength of the steel.

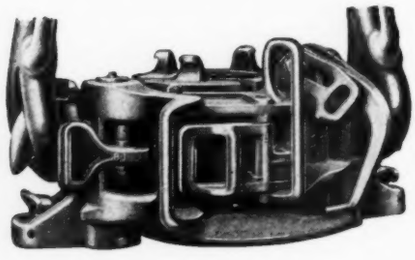
As to its field advantages, the engineers of the A. O. Smith Corporation say that in many cases lighter strings of casing may be run, and the same resistance to collapse obtained, and that the driller will be able to go to greater depths in larger sizes than heretofore.

Complete details on the practical and scientific characteristics of the casing will be published in a bulletin to be released within the next 30 days, according to the company.

Branch offices of the A. O. Smith Corporation are now operating at New York, Tulsa, and Los Angeles. An office at Houston is being established.

Flexibility in Operation Provided by New Slip Elevator

AN improved type of side-door slip elevator for casing or drill pipe has been announced by the Byron Jackson Company, 2150 East Slauson Avenue, Los Angeles, California. This elevator is designed to handle long strings of pipe without allowing any of the weight to be carried by the coupling or collar. With four long slips to grip on the pipe at any point, it has many times the capacity required to handle the longest and heaviest strings ever run. It is extremely simple in operation and requires only one man on the derrick board when setting casing.



The side-door construction of this elevator permits it to be placed on or removed from the casing without disconnecting or removing the circulating or cement heads. It is readily released for use elsewhere while new cement is setting. Two safety latches hold the side door positively closed and locked. The door interlocks with the body in a manner that minimizes any outward thrust against the door to prevent it from being opened while the load is being carried.

The door and body of the elevator carry four interlocking extra-long, spring-floated slips that set uniformly and evenly around the entire circumference of the casing. The slips are of such large area that they prevent crimping or crushing of the pipe under the heaviest of loads. Each elevator accommodates several sizes of slips so that one size elevator is sufficient to handle a wide range of pipe sizes. Less than ten minutes time is required for changing from one size slip to another.

Either of two methods may be used in setting the slips of the new BJ Side Door Slip Casing Elevator: (1) Since it is impossible for the pipe collar or upset to pass through the slips after the door has been closed, the elevator can be placed on the pipe and the slips set automatically when the collar or upset contacts them; (2) The slips can be set several inches below the collar by means of a conveniently located slip-setting handle. This method is particularly desirable when setting flush joint casing where the absence of the collar ordinarily presents difficulties.

An additional safety feature of this new type slip elevator is a manually operated slip lock. When the slips have been set by either method, they can be locked in the set position to prevent any accidental release. The slip lock is simply moved into position over the adjacent slip; and since all slips are connected, they all remain safely set until the load is released and the lock withdrawn by the operation. The danger of having slips disengage from any cause while the pipe is in the hole is thus eliminated.

Complete details on the setting and locking mechanism will be furnished by the manufacturer upon request.

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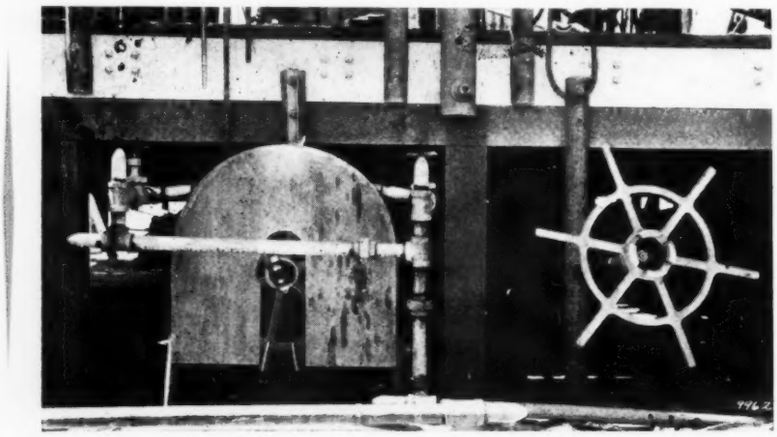
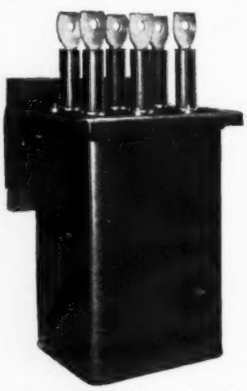
Shaffer Cellar Control Gate Combined With Pelton Wheel

THE accompanying illustration shows a recent development of the Shaffer Cellar Control Gate combined with the Pelton Wheel for mechanical closing. In this installation the Pelton Wheel is inclosed in a hood that greatly increases the efficiency of the steam jet. Having two jets, the wheel may be turned either way and the gate opened or closed by steam pressure. The use of the Pelton Wheel in no way interferes with the manual operation of the gate. The handwheel may be attached with a lazy rod and universal joint connection to the hub of the Pelton Wheel. The equipment is manufactured by the Shaffer Tool Works, Brea, California.



General Electric Announces Small Oil Blast Circuit Breaker

AN oil blast circuit breaker especially applicable where space is limited, such as in industrial plants and other stations, has been announced by the General Electric Company. Designated as Type FK-42, it is rated 600 amperes, 7500 volts; 800 amperes, 2500 volts; and 25,000 kva. interrupting rating. All the designs are double- and triple-pole single-throw, with all poles in a single rectangular welded plate steel tank. Provision is made for mounting directly back of panels, or in switch houses or metal-enclosed switchgear. They may be manually or electrically operated.



Features of the new FK-42 breaker include: Compact construction; silver-to-silver main contacts protected by arcing contacts, providing long life and low maintenance; oil blast baffles assuring high speed interruption with short arcs and minimum oil deterioration; sturdy Herkolite bushings giving high mechanical and dielectric strength; single tank for all poles, saving time during inspection and giving compact, space-saving construction; frame and tank completely fabricated of plate metal, with all joints electrically welded; internal mechanism with entire absence of external moving parts, increasing clearance and facilitating connections; and simple and positive internal mechanism construction, assuring long life, ease of maintenance, and high speed operation.

A complete line of accessories, including overcurrent trip coils, both instantaneous and inverse time delay (for manually or electrically operated breakers), undervoltage devices, auxiliary switches, steel supports, etc., are available. available.

New Type Hose for Pneumatic Tool and Air Drill Service

THE Mechanical Goods Division of U. S. Rubber Products, Inc., 1790 Broadway, New York City, has announced a new type hose for pneumatic tool and air drill service—the U. S. Super Royal Cord, an air hose built like a tire.

The outstanding feature of the new hose is its "tire-like" cords laid in tough rubber cushions isolated from adjacent plies to prevent rubbing or shearing, the manufacturers state. "U. S." claim that this hose can withstand any amount of pulsation, sudden expansion under pressure, and constant flexing in use.

This new hose carcass makes U. S. Super Royal Cord so tough, it is said, that it shows remarkable resistance to external blows, bruises, and abrasions. This durability is due not only to the internal structure, but to the specially compounded brown rubber cover that will stand unusual abuse and will not peel when cut or gouged.

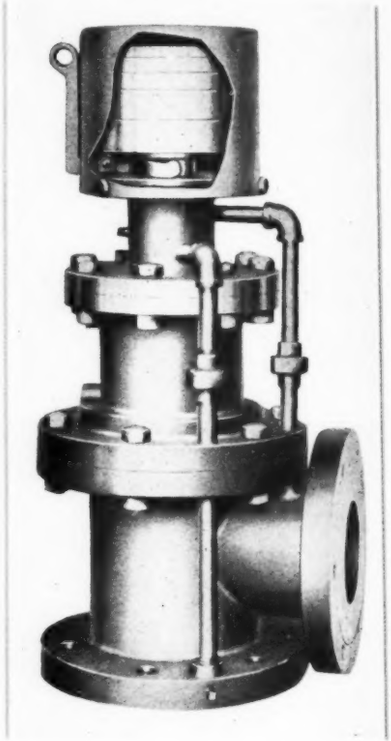
For additional protection against the destructive action of hot oil in the air line, the tube of the U. S. Super Royal Cord is made of the finest oil-resistant rubber.

The Mechanical Goods Division of United States Rubber Products, Inc., is enthusiastic in its claim for this new hose.

Mid-Continent Automatic Relief Valve

THE Mid-Continent Supply Company, Fort Worth, Texas, are manufacturers and distributors of the Mid-Continent Automatic Relief Valve for installation on manifolds and pumps of oil pipe lines, and designed to eliminate excessive pressures caused by surges or improper operation of gate valves on main lines some distance from the station. The valve has no seats and no springs and operates entirely by pressure through the use of specially-hardened pistons and sleeves. All valves are made from high-tensile cast steel and are tested to 2000 pounds.

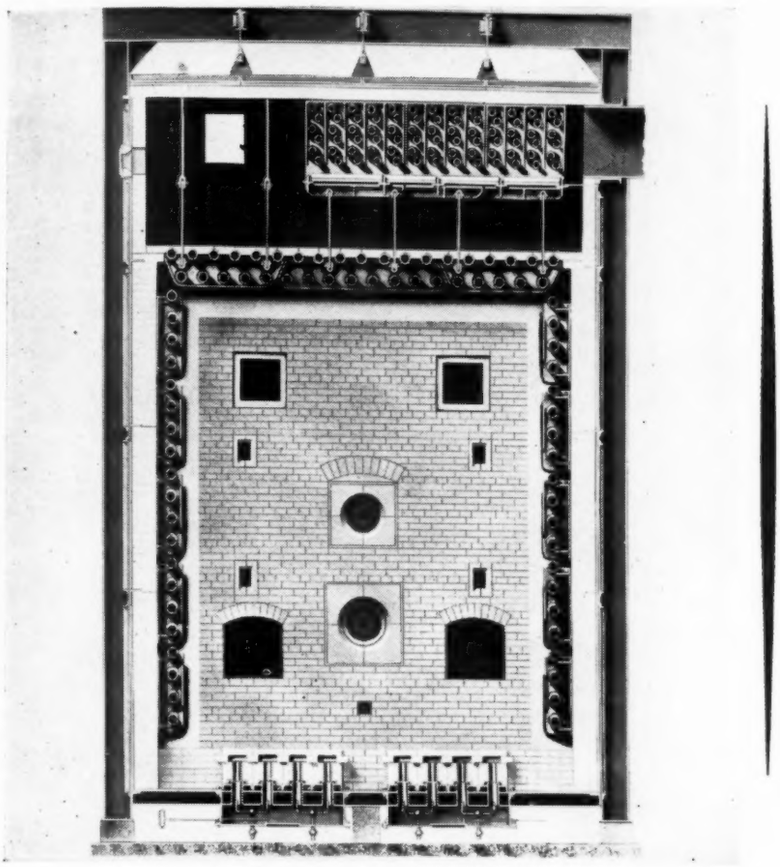
The relief valve can be set to relieve working pressure from 100 lb. to 750 lb. by simply removing lead weights for reduced pressures and adding lead weights for increased pressures (as shown in the upper casing of the accompanying illustration). By means of this adjustment the valve can be set to relieve at 15 to 20 lb. above the desired working pressure and to cut off automatically at 60 lb. below working pressure.



The pipe is connected, at the bottom of the relief valve, to the control head cylinder, and the control piston is kept in position by lead weights. As the pressure rises above the desired working pressure the control head piston lifts, changing the ports and discharging the working pressure in the power cylinder (shown in center of valve—see illustration) into the relief side of the valve or suction line. At that moment the main relief valve opens, releasing excess pressure into the suction line. When the pressure drops below the desired working pressure, the control head piston, carrying the weights, returns to its original position, cutting off relief of power cylinder and then permitting pressure to enter the power cylinder, thus forcing down the lower piston, thereby closing the relief opening of the main relief valve.

Lummus Oil Heater

THREE installations of the new design Lummus Oil Heater, manufactured by The Lummus Company, 50 Church Street, New York City have been made. The first installation now has been in operation approximately two years, running on a topping operation. Another installation has been in operation for a period of six months in oil cracking service, and the third, also being employed in cracking service, was installed recently. Engineers of The Lummus Company are now enabled, by observing their practical application, to determine their efficiency over a period of time, and they report that recent inspection of these heaters indicates efficient operation will be maintained indefinitely with a minimum of upkeep.



Cross Section of Lummus Oil Heater

In oil heating for distillation and cracking units the modern trend is toward high heat transfer rates, because of the economies both in first cost and in operating costs. To obtain the advantages resulting from high heat transfer rates, however, requires that certain essential factors in high temperature furnace design be provided. It is necessary that there be a sufficient velocity of oil flow in the tubes to absorb the heat. High velocity of the oil results in increased pressure drop but that is counterbalanced by the decreased amount of surface through which the oil has to be pumped when high transfer rates are utilized.

Sufficient radiant heating surface to maintain transfer rates that avoid coking or overheating of the oil also is necessary.

Arrangement of heat absorbing surface to provide uniformity of heat absorption and to avoid local heating is required. This necessitates that all heating surface be in approximately the same relation to the region of the liberation of heat and that large radiating refractory surfaces be avoided.

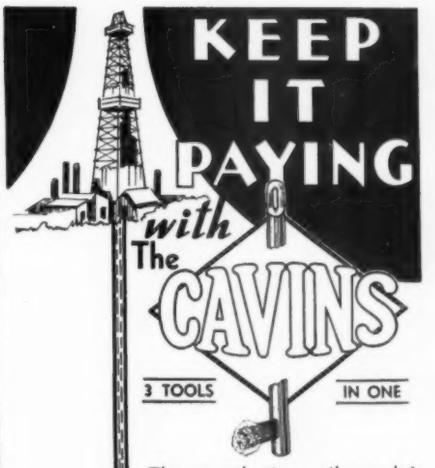
Provision must be made for removal of the products of combustion from the furnace in a manner that reduces to a minimum the convection transfer of heat on any surface exposed to radiation. This avoids local overheating due to the combined radiant and convection transfer of heat.

An efficient convection section is necessary.

Essential is the use and arrangement of furnace walls of low heat storage capacity so that the heaters cool quickly both for cleaning purposes and, in case of pump failures, to avoid coking of the oil that remains stagnant in the heater.

The Lummus oil heater accomplishes high heat transfer rates and embodies these elements of design essential to safe, successful, and economical operation, engineers of the company state.

The Lummus oil heater is of the rectangular box type with the two side walls, the roof, and sometimes the floor of the radiant section, covered with heat-absorbing surface. The end walls are used to install observation and access doors and burners. Above the radiant section is a plenum chamber for collecting the flue gas, and immediately above that is the convection section. The flue connection is made on the side of the heater at the top.



The producing oil sand is the very heart of your well. Thousands of dollars were expended for drilling and equipping the well in order to reach and produce that oil sand. All the equipment from the crown block to the bottom of the hole is salvable. But you can't salvage production that is *lost*, or a well that is plugged or killed through sanding up.

The CAVINS

RAISES PRODUCTION: by removing all loose and packed sand and creating a larger drainage area, and by thoroughly cleaning the perforations or screen.

RECOVERS JUNK: cones, rollers, broken discs, slips, pieces of iron, rubber, rope and articles of every description weighing up to 40 pounds are recovered by the Cavins with a junk basket or trap attached to bottom.

SAVES TIME: The Cavins operates at high speed. No spudding. Run in—trip—pull out. It loads and dumps automatically. Allow three seconds for loading; thirty seconds for dumping.

SAVES FLOWING WELLS: by cleaning out sand bridges inside the tubing. Saves killing and pulling.

DON'T LOSE IT!

Keep your well producing profitably . . . protect the vital spot of your investment . . . with The Cavins.

THE CAVINS COMPANY

2853 Cherry Ave., Long Beach, Calif., U.S.A.

Cable Address: "Cavins, Long Beach"

Foreign Representative: R. J. EICHE

Branches at

Taft, Bakersfield, Goleta and Santa Paula, Calif.

Cavins Clean-Out Service:

Oklahoma City, Okla., and McPherson, Kansas.

Cavins Bailer Service:

Houston and Kilgore, Texas, and Shreveport, La.

Reversible Feature Added to Ingersoll-Rand Pott Impact Wrench

THE Ingersoll-Rand Pott Impact Wrench can now be furnished with a reversible mechanism, so that it can be used both for applying and removing nuts, it is announced. The reversing is accomplished by shifting gears instead of reversing the air motor. This method was adopted because a non-reversible multi-vane motor uses about one-third less air than a reversible motor of comparative size, the manufacturers state. It also prevents accidental reversing, thus adding to the safety of the wrench, it is pointed out.

Another feature that has been added is the air cooling of the accumulator, which prevents overheating and results in longer life.

This new wrench runs nuts on or off at a speed of approximately 600 to 700 r.p.m. and 1200 to 1400 impacts per minute, tightening or loosening.

As torque is applied to the accumulator (rubber) the twisting action shortens the rubber section, thus lifting the hammer from its seat. The energy stored in the accumulator drives the hammer forward so that it delivers a powerful rotary blow to the anvil, on the end of which is attached a chuck. These torsional impacts, occurring at the rate of 1200 to 1400 per minute, exert a powerful turning effect. This type of turning action makes it possible to remove nuts that could not be taken off otherwise except by splitting with a chisel or burning with a torch, the makers say.

A 16-page bulletin, form 2152-A, has been issued. It shows illustrations of the impact wrench being employed at a wide variety of tasks. Copies may be obtained from Ingersoll-Rand Co., 11 Broadway, New York City, or any branch office.

Gearench Record Size Break-Out Tong

GEARENCH Manufacturing Company, Houston, Texas, is now making the Petol No. 20 Bull Tong, the largest ever built for oil field use, as standard Petol equipment following the success on a number of unusually hard jobs for which it was designed and constructed as special equipment.

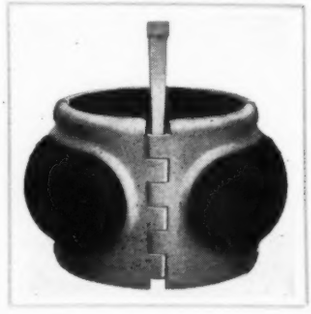
This tong, the type for general break-out work, is described as capable of producing 4,000,000 inch-pounds turning torque. Material used is highest quality chrome nickel and chrome vanadium steels, while the tong is equipped with multiple high speed steel teeth inserts.

The No. 20 tong handles conveniently any outside diameter from 6-in. to 22-in., eliminating the necessity of frequent alterations for various size requirements.

Grizzly Drill Pipe Protectors

ONLY a few seconds—and no special tools—are required to install Grizzly Drill Pipe Protectors, but once installed they hold with a never-failing grip all the way to the bottom of the deepest wells—and out again, states the manufacturer, E. M. Smith Company, Los Angeles, California.

The Grizzly protector is locked on by lightly tapping a tapered locking key into a special dovetailed locking arrangement, and due to the tremendous grip thus obtained it cannot slip, pile up, overlap, or snap off, it is claimed. Although locked on the pipe so firmly that it will withstand any blow or strain ordinarily encountered in service without being moved from its original position, it is easily removed when



out of the hole by simply tapping the locking key out of its position with a light hammer, it is pointed out.

Grizzly protectors have been used all the way to bottom of the deepest wells in the world, and still were firmly locked on the pipe, and in good serviceable condition, when pulled out of these deep holes, the manufacturers state.

The extra large wide solid rubber bumpers and body are made flat in one piece, eliminating any expansion strain and providing a solid rubber cushion against the pipe to absorb shocks. Large double circulation passages allow free circulation and relieve pressures on pumps and working parts.

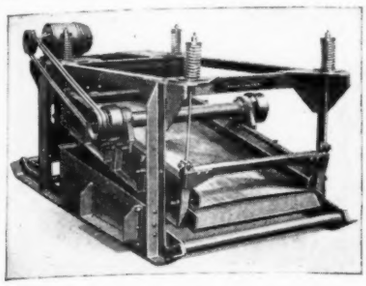
Grizzly protectors are manufactured by E. M. Smith Company, Los Angeles, California, and distributed by T. T. Word Supply Company, Inc., Houston, Texas, in all their stores.

Manufacturers designing or developing bradenheads are cautioned to read carefully Patents No. 1834968 and No. 1869739 in order to avoid possible infringement. These Rector Patents, together with others now pending, cover a tapered solid suspension as well as a split ring suspension, either of which forms a metal to metal shut-off below replaceable packings.

RECTOR WELL EQUIPMENT CO., Inc.
Fort Worth, Texas

Allis-Chalmers Shale Shaker

THE Allis-Chalmers Shale Shaker is a mud-screening unit, consisting of a mud-feed box, vibrating screen and mud discharge, all mounted on a heavy steel frame and skids. Any standard mud-flow pipe can be connected to one or more



covered openings in the feed box or, if preferred, a feed trough can be used.

The vibrating screen is "free swung" on coil compression springs and driven through V-belts from an electric motor or steam turbine mounted "dead" out of the way on top of the frame. Angle of screen can be changed by simply turning nuts above the coil springs. "Arch-Braced" screen cloth is in two sections, with automatic constant tension. Intensity of vibration is easily adjusted from minimum to maximum with no removable weights.

Allis-Chalmers Shale Shaker, size 3 ft. by 6 ft., is described and illustrated in leaflet 2198. If interested write for copy to the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.

Alligator Belt Cutter

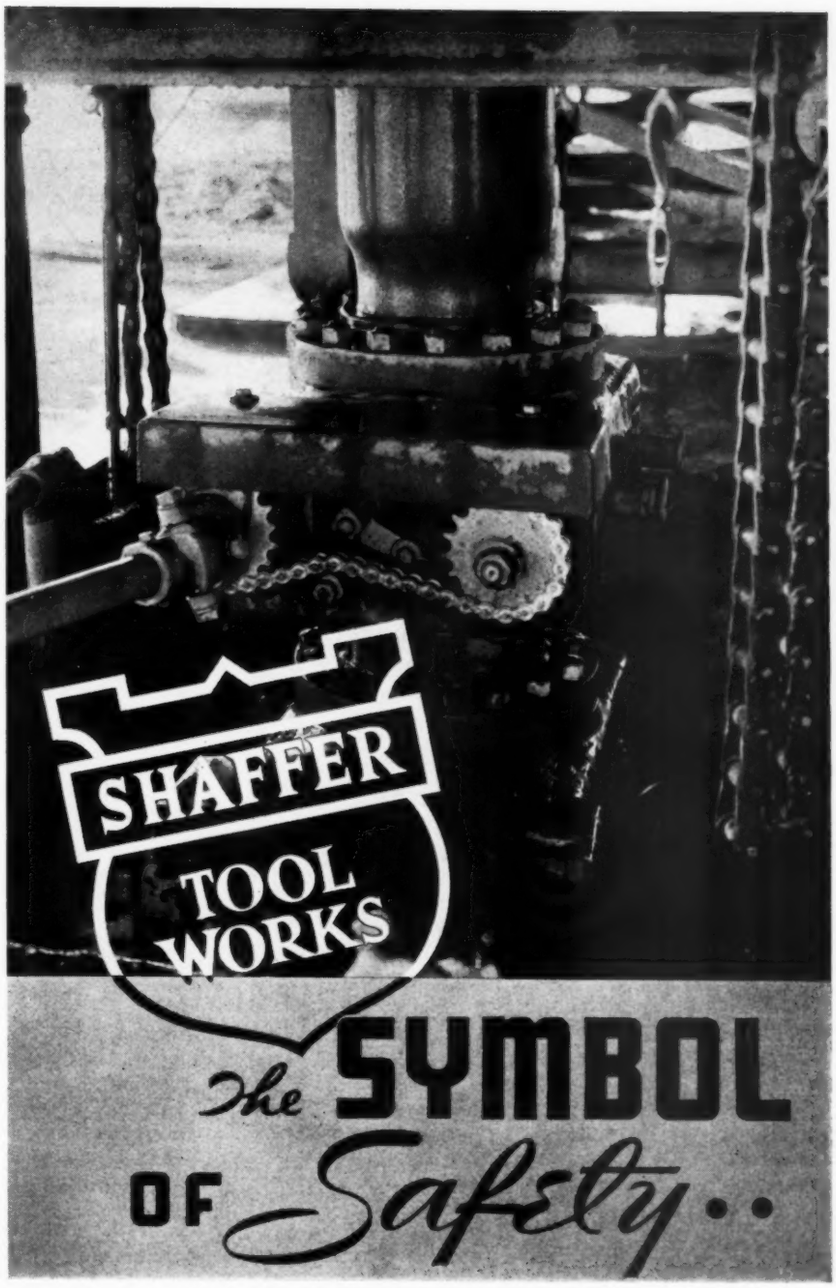
AN 8-in. flat belt cutting tool (U. S. Pat. 1,992,600), employing a new principle in mechanical belt cutting, is announced by the Flexible Steel Lacing Company, 4607-31 Lexington Street, Chicago, Illinois. The cut is made by pushing the knife through the belt from one edge to the other. The knife is mounted on a

plunger in a slot, as illustrated, and is operated easily by a direct arm push without mechanical leverage.

The knife goes "like cutting cheese" through most belting, but it will cut even the thickest and toughest belts up to 8 in. in width with surprisingly little effort, the manufacturers state. The knife, of special alloy steel, will make several thousand cuts and is easily replaceable.

The belt is held immovable by the equalizing clamp or hold down while the cut is being made. The clamp is also a guard for the blade. Clamp and frame are strongly built of aluminum alloy, the weight of the cutter being only four pounds and three ounces.

The cutter is used either on the bench, as illustrated, or is up-ended on the floor, if desired.



Wherever you see the Shaffer shield you know that oil men are protecting their investments with equipment that is noted throughout the world for its safety. For over seven years Shaffer Cellar Control Gates have been recognized as the ideal means of preventing blowouts.

Since a Shaffer Gate installation is rarely left on the well when it is completed the cost per well is extremely low.

Can you afford to be without this dependable low cost insurance against blowouts and losses?

SPECIALISTS IN HIGH

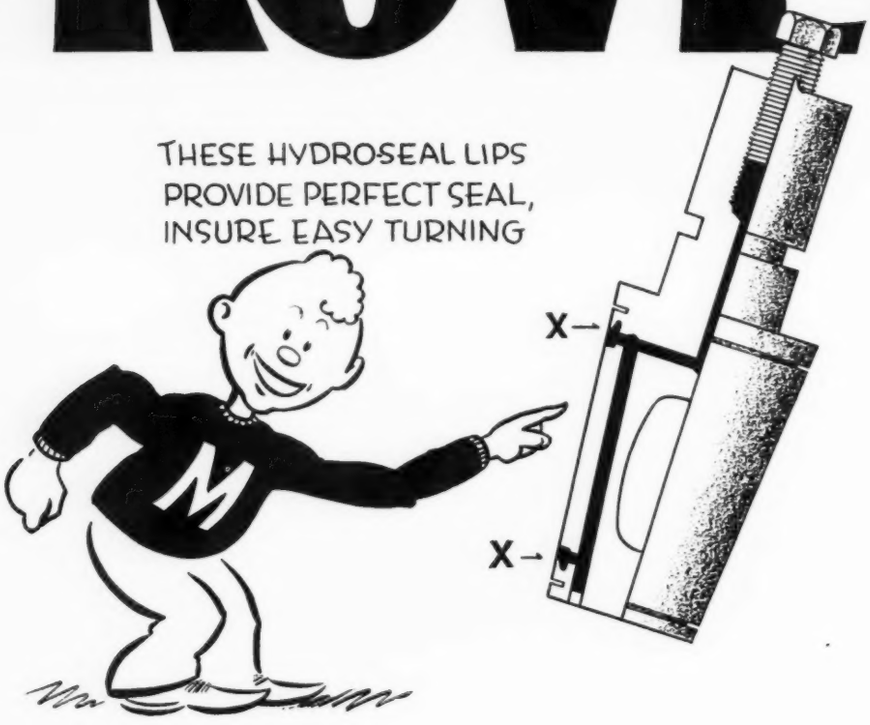
SHAFFER TOOL WORKS

PRESSURE EQUIPMENT

BREA, CALIFORNIA **HOUSTON, TEXAS**

EXPORT — OIL WELL SUPPLY COMPANY

PROVEN

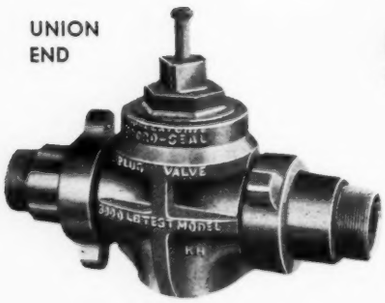


"Hydro-Seal" Lips constitute the greatest improvement in PLUG VALVES since their conception. Undercut grooves in the surface of the plug form metal "Hydro-Seal" lips which are expanded by grease pressure applied by a booster screw. The fine, razor-like edges of the "Hydro-Seal" lips engaging against the wall of the body make escape of pressure impossible.

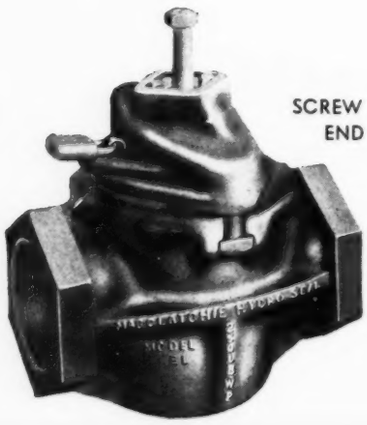
Since no cup leathers nor compressible packings are used friction is reduced to a minimum. The bearing surface between the plug and the body is amply lubricated. In the High Pressure Models the plug rotates on a ball race.

MacCLATCHIE MANUFACTURING CO.
COMPTON, CALIF. HOUSTON, TEXAS

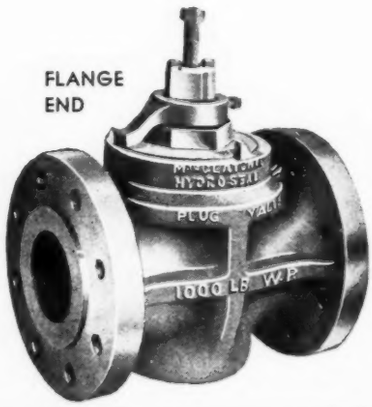
UNION END



SCREW END



FLANGE END



MacClatchie "Hydro-Seal" Plug Valves are made in working pressures from 150 lbs. to 3000 lbs. They are made in screw, flange, and union ends, hand or gear operated.

Write for our Plug Valve Catalog

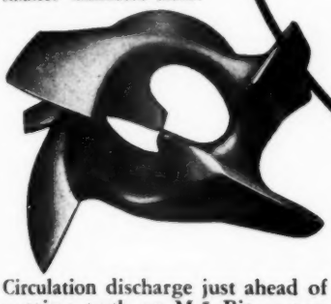
"IT'S ALL IN THE LIPS"

HOLE MAKERS

that really cut faster, straighter, full-gauge hole for [illegible] per foot

GLOBE BITS

Type M-5 Bits are similar to Type B-3 (large center view) but for smaller diameter hole.



Circulation discharge just ahead of cutting teeth on M-5 Bits means faster digging.

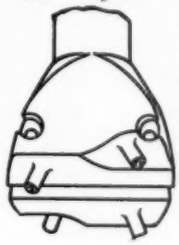
Six reaming edges on the Type B-3 Bit maintain a full-gauge hole. See also large illustration of this bit in center.

Globe Types B and C Bits are specially recommended for tough shales.

The serrated cutting edges cut rapidly with minimum weight on the string.

Circulation directed against teeth of Type B Bit speeds up cutting action.

Some operators prefer the cutting teeth set in the X-design of Type C.



Four flow beans direct the force of circulation against the cutting edges of the Type B-3. See stepped design of teeth in center illustration.

DRILLING, REAMING AND CORING EQUIPMENT

Look for this Trade Mark in the Composite Catalog

GLOBE OIL TOOLS

GLOBE OIL TOOLS COMPANY
(Los Angeles County)
Los Nietos, California, U.S.A.

Engineering Fundamentals Department

- A Study Course for Field and Plant Men
- A Review for Experienced Engineers

W. L. NELSON
K. C. SCLATER
Editors

Elements of Applied Petroleum Production

By K. C. SCLATER

Article 22

CLEANING-OUT AND REPAIRING WELLS

AFTER a well is completed and placed on production, the frequency of cleaning-out and the necessity for repairs will depend on several factors, among the most important of which are:

1. The physical character of the producing sand.
2. The manner in which the well was completed.
3. The production method and equipment employed in the well.

In order to keep a well producing efficiently, whether it is flowing or pumping, it should be given systematic care. A record of its rate of production and operation will usually disclose when a well needs to be cleaned out or requires repairs.

No standards can be set up for cleaning-out or repairing wells. The method used will depend on the character of the producing formations. Soft unconsolidated sands and shales will usually cause trouble from caving or from fine sand and silt coming into the hole, making frequent cleaning-out necessary. In formations of this type it is usual to set a liner of perforated pipe or screen opposite the producing sand such as is commonly done in the fields of the Gulf Coast and California.

Where the producing formations are hard and do not disintegrate in the hole, cleaning-out operations generally are less frequently necessary. Wells may even be produced without using liners in the producing sand. Many wells in the Eastern fields and in the Mid-Continent are of this type.

Sand and cavings in a well are generally removed by bailer or sand pump. If the cavings are packed hard in the bottom of the hole it may be necessary to run the tools.

In hard producing formations, swabbing may be resorted to in cleaning-out a well. Loose particles in the producing formations can sometimes be drawn into the hole and carried out at the surface by swabbing. This method of cleaning-out is not adaptable to loose cavey formations. Neither is swabbing advisable if there is a possibility of water being drawn into the hole; or should the well already be making water, swabbing may increase it. Where fine sand comes into the hole with the oil in hard producing formations and there is no danger from water, swabbing is an effective cleaning-out method.

In pumping wells where the pressure is not high and no liners are necessary, hot or cold liquids such as water, oil, or gasoline may be used to wash the face of the sand and remove all loose particles from the walls of the hole. Care has to be taken in using water to be sure that no shales are exposed in the hole as these are likely to cause trouble from caving. The method of introducing liquids is by "washing down" through tubing or lowering the liquid by dump bailer into the hole. The latter method should be used with water if there is any tendency for the formations to cave.

Small pumping wells are the most widespread and the kind that confront the operator with cleaning-out problems. The rate of production is so low in this type of well that cleaning-out costs must be carefully watched. Small wells are numerous and cleaning-out is so important that economical methods for cleaning-out have been devised by operators from time to time. Some of these methods will be discussed first before describing the cleaning-out and repair practices in general use.

CLEANING-OUT WITH HEATED OIL

One method of cleaning oil wells consists of an initial treatment and a continuous treatment with heated oil. In adopting the continuous treatment it is assumed that in most wells regular cleaning-out methods are only of temporary benefit. In the average well, for example, as the pores at the face of the producing sand exposed in the hole become clogged up, the production gradually drops. When the face of the sand is cleaned, the rate of production increases; but gradually declines after a time as the pores become clogged again so that the cleaning-out process has to be repeated. Each cleaning-out operation requires that the rods, pump, and tubing be pulled. By keeping the pores of the sand open after the well is

cleaned-out the necessity for pulling the rods, pump, and tubing is obviated.

Means of keeping the pores open by the use of heated oil "in its simplest form consists in pumping oil or the fluid contents of the well by means of the pump in the well, as in the regular procedure of production, to the surface, causing it to flow through a gas or oil-fired heater and thence, in a heated condition, back to the well and over the face of the pay sand. As the oil, appreciably reduced in temperature by flowing over (the face of) the sand, reaches the bottom, it is drawn into the working barrel and returned to the heater at the top of the well."[88] During the period of heating, the hot oil is circulated in the well continuously.

In very small wells in old fields "it has been found in practice that 24 hours of hot washing will practically free the well of paraffin or asphalt obstructions to flow"[88] and without retarding the rate of production. During the initial treatment the rate of flow may even be increased.

"It has been found in using this process that oil, heated to 300 deg. to 450 deg., entering the well at one to three gal. per min., will return to the heater at the top at 110 deg. to 150 deg. and that these temperatures are highly effective. Under these conditions the temperature at the bottom of the well becomes such that leather cups and washers are destroyed and fibre or canvas must be used."[88]

With regard to the practical application and costs of the process of cleaning wells by heated oil, W. J. Knox[88] states that the "process was first tried out on wells 35 years old, 1200 ft. deep, and producing oil of paraffin base in Allegany County, N. Y. Oil from the well was passed by means of the oil-well pump through a thermostatically-controlled heater, heated to 310 deg. fahr. and returned to the well through a 1-in. pipe and discharged at a point near the top of the pay sand. Thence the hot oil flowed downwards over the face of the pay sand and melted and dissolved the paraffin wax deposits. The oil was continuously pumped back to the surface into a small tank to allow wax and dirt to settle out, thence through the heater and back into the well to heat the sand or rock. The rate of pumping was three gal. per minute.

"The production of the well previous to treatment was seven gal. per day. The washing or deparaffining took place rapidly. Twenty-four hours of treatment increased the production to 30 gal. per day. At the end of 72 hr. the production had increased to 35 gallons. At the end of four months, the daily production was still about 35 gallons. The gas consumed in heating the oil entering the well was 21,600 ft. and cost 30 cents per thousand feet or $6.48.

"The increase in production was 28 gal. per day. Instead of four months, call the period of augmented flow 90 days before treating the well again and we have a total for 90 days of 2520 gal. or 60 barrels. This is a fuel cost of 10.8 cents per bbl. for oil now selling for $3.85 per barrel. Or in gross figures $6.48 in fuel produced $231 in oil in three months. As the pumper attended to the heater the labor cost was not large.

"Another test was made on wells producing paraffin base oil in Warren County, Pa. These wells were deeper, namely, about 1800 ft. and heavily paraffined up. Only one gal. of oil per min. was flowed over the face of the pay sand, but the temperature of the oil was raised to about 450 deg. fahrenheit. Large quantities of yellowish paraffin wax, amounting to approximately 300 to 400 lb. was chilled out in the small receiving tank, and the deparaffined oil was then pumped through the heater and returned continuously to the well. The treatment was not completed on account of a breakdown of the heater, but the results were equally good as in the former tests.

"It was next decided to try the process on straight asphalt wells in the Mid-Continent. A lease was selected near Coffeyville, Kansas. The wells were 25 years old, only 625 ft. deep and with a depth of sand of about 25 feet. The time of treatment was 74 hours. The previous rate of production of the wells, over a period of two weeks was 34 1/3 gal. per day. Three weeks after treatment the gauge showed 70 gal. which gradually increased to 85 gal. at the end of six weeks. At the end of three months the production was still 85 gal. per day.

"In all cases it was found that the heat at the bottom of the well was so high as to carbonize and destroy leather cups and washers, and canvas or fibre cups had to be used.

"At Coffeyville the operation was carried on practically continuously which necessitated the use of the 20-hp. 'power' for pumping the one well. Equally good results can be had by carrying on the treatment only during the regular pumping period, in which case the pumper on the lease can look after the portable automatic heater so that there need be no extra charge or only a slight charge for labor. The cost of fuel for heating in Kansas was arrived at by deducting the gas charge from a service line for the previous month from the charge during the month in which the treatment was carried on. This amounted to $27 for gas for heating the oil and running the power, and for gas burned to keep the men on duty warm.

"The increase in production at Coffeyville was 50 2/3 gal. per day. Call this 50 gal., or 1.19 barrels. This is 434.5 bbl. per year of 18,250 gal., worth at $1.55 per bbl. $673.48. The previous income per well, at 34 1/3 gal. per day was a little less than 300 bbl. per year, or only $465.00, but with the augmented production the gross income was increased to about $1140 per well. Based on 100 similar wells the old income would be $46,500, from which all operating costs had to be paid and the new augmented income would be $114,000, an increase of $67,500 per year. The cost of operation, installation and maintenance which would be deducted from this gross profit is very small."

Low-pressure superheated steam is also used for cleaning-out small oil wells. By superheating the steam condensation is reduced and a higher temperature and pressure are available at the face of the sand. The steam is played against the face of the pay sand through a short joint of pipe perforated with fine holes and hung on a string of tubing that is plugged on bottom.[89]

●

QUESTIONS

1. How does the physical character of the producing sand affect the frequency of cleaning-out operations on a well?
2. What precautions are necessary when using water for cleaning-out a well?
3. On what type of well and for what purpose is swabbing suitable in cleaning-out operations?
4. Describe briefly the process of cleaning-out small wells with heated oil.
5. What should govern the temperature of the oil used for heating?

REFERENCES

88"Cleaning Oil Wells by Heated Oil," by William J. Knox—A.I.M.E. Petroleum Development and Technology, 1925.

89"Cleaning Oil Wells With Low Pressure Superheated Steam," by J. A. Crumley—*The Petroleum Engineer*, Midyear, 1930.

Elements of Applied Petroleum Pipe Line Transportation

By C. E. MAIN, SR., Engineer,
Sinclair-Prairie Pipe Line Co.

Article 13

FLOW OF LIQUIDS IN PIPE LINES (Part II)

PLOTTING a curve of the experimental values of $(f\mu)$ as a function of any one of the criterions or arguments mentioned, is properly called the Stokes form of diagraming and according to this plan of analysing experiments, the exponents x, n, and w are related, since only one line is required for all diameters, velocities, and viscosities, whether it be straight, angled, or curved.

Related exponents are those in which:

$$(x + n) = 3$$
$$(n + w) = 2$$
$$\text{and } (2n + x + w) = 5.$$

Unrelated exponents give a separate set of diameter curves for each viscosity, as well as a separate curve for each diameter.

Fig. 1

Key to Graph Shown on Pages 82 and 83

TEMPERATURE—VISCOSITY CURVES

The graph comprises 17 curves of which 6 are gasoline, 1 kerosene, 1 distillate, and 8 are crude oil, as follows:

GASOLINE

Curve 29	70.0 deg.	A.P.I. by Coulthurst and Scoville
Curve 28	65.0 deg.	A.P.I. by Coulthurst and Scoville
Curve 10	70.3 deg.	A.P.I. by Herschel
Curve 12	58.9 deg.	A.P.I. by Herschel

KEROSENE

Curve 9	42.5 deg.	A.P.I. by Herschel

DISTILLATE

Curve 4	34.0 deg.	A.P.I. by the Author

CRUDE OIL

Curve 2	35.6 deg.	A.P.I. Seminole (Composite)
Curve 6	42.1 deg.	A.P.I. Pa.—Bradford
Curve 7	41.9 deg.	A.P.I. West Texas
Curve 3	35.6 deg.	A.P.I. Kansas and Oklahoma Pipe Line Crude
Curve 8	.....	Wilcox well, Pampa, Texas
Curve 23	38.3 deg.	A.P.I. Kansas and Oklahoma Pipe Line Crude
Curve 30	28.4 deg.	A.P.I. Winkler Crude
Curve 31	32.6 deg.	A.P.I. 60 percent Deval, 40 percent Nacona

ARGUMENT—CHEZY FRICTION FACTOR CURVES

Curve 1	Lees
Curve 2	Durand
Curve 3	Stanton and Pannell
Curve 4	Wilson, McAdams, and Seltzer
Curve 73	Thomas
Curve 74	Kite and Kennedy
Curve 75	Kinney Manufacturing Company
Curve 77	Hydraulic Society
Curve 78	Author
Curve 25	McGregor 3-in. Curve 50 (SUS)
Curve 33	" 4-in. " "
Curve 41	" 6-in. " "
Curve 49	" 8-in. " "
Curve 57	" 10-in. " "
Curve 65	" 12-in. " "
Curve A	Fanning Composite of 10 Diameters, k=1.0

From the writer's experience in analysing the experiments taken from the Hydraulic literature, together with several hundreds of his own that were made under fairly favorable conditions, it is obvious that they do not possess the required accuracy to entitle them to be classed as scientific experiments. In this investigation, to determine independently the values of x, n, and w, it was found that they always produced straight lines in logarithmic plotting and a separate parallel line for each diameter, which denotes unrelated exponents; however, these findings are not conclusive in favor of the unrelated exponents.

It was Reynolds (1883) who first showed that the exponents were related, but later, in 1886, Professor Unwin made a very careful investigation and failed to support Reynold's contention.

The writer has found in petroleum pipe line practice that Equation (1) may be expressed in a more convenient form for single line computation:

$$h = \frac{Abk^w MB^n}{2gD^{(2n+x)}} \quad \ldots\ldots\ldots\ldots \quad (4)$$

in which:

$$A = \frac{5280 \times (12)^x}{(3.497)^n}$$

and $Log\ 3.497 = 0.5437124$.

B = bbl. of 42 gal. pumped per hour

M = length in miles

D = dia. of pipe in inches

N = number of parallel lines of D diameter and for a system of parallel lines of a given diameter:

$$h = \frac{Abk^w MB^n}{2gN^nD^{(2n+x)}} \quad \ldots\ldots\ldots\ldots \quad (5)$$

In order to reduce the pumping pressure to its equivalent head in ft. of liquid, Equation (6) may be used:

$$h = \frac{(131.5 + G)\ P}{61.287} \quad \ldots\ldots\ldots\ldots \quad (6)$$

and $Log\ 61.287 = 1.787370$

in which:

P = gauge pressure in lb. per sq. in.

G = observed gravity in A.P.I. deg. for temperature of liquid in lines

t = Saybolt Universal Viscosimeter seconds.

If the viscosity of the liquid is obtained from a Saybolt Universal Viscosimeter, the equivalent kinematic viscosity in centipoises may be computed from Equation (7):

$$k = 0.216\ t - \frac{180}{t} \quad \ldots\ldots\ldots\ldots \quad (7)$$

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TICO Full Diesel Engine Type "C"

10½" x 14"
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You buy twenty years, not twenty months, of service when you buy the new Tico Diesel, because it's built that way. The slow speed, massive construction and high reserve power, which is inherent in the new Tico Full Diesel Oil Engine, all combine to give extraordinary long life and economical service.

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The Titusville Iron Works Company
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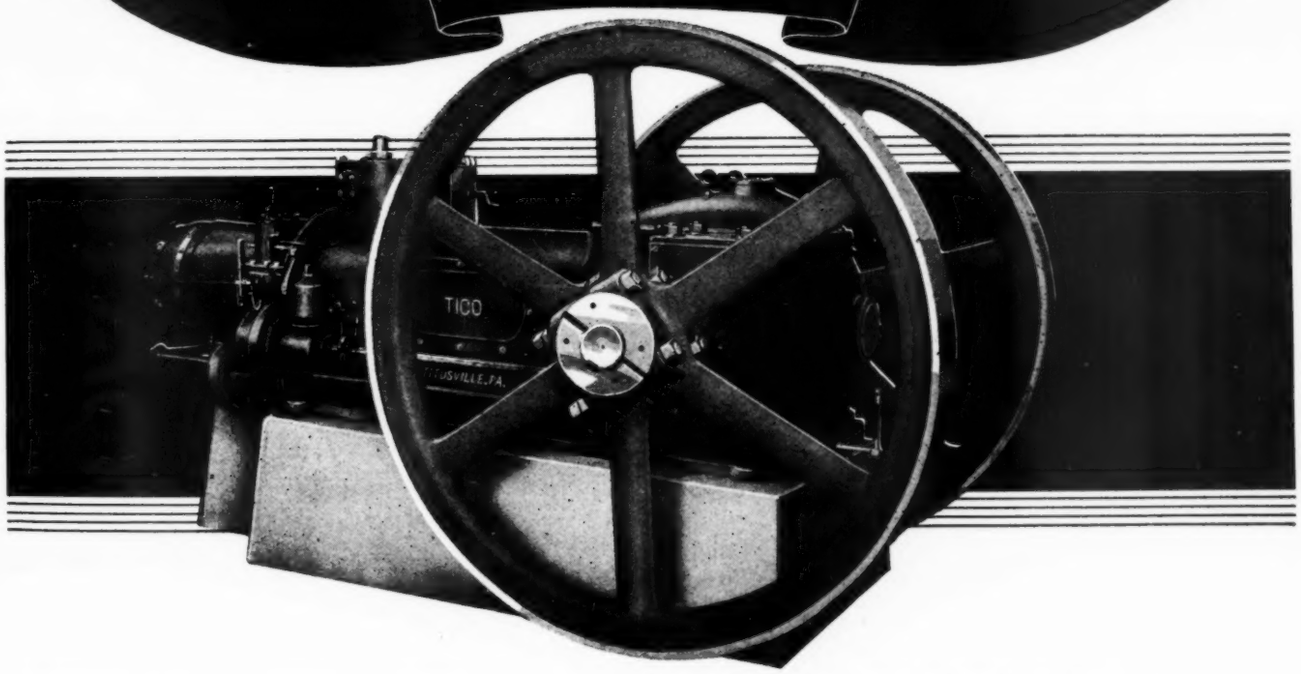

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Viscosity determinations of liquids less than 35 seconds, must be timed to the nearest 0.2 second for each temperature run, and the temperature-viscosity curve should extend several degrees both ways from the actual temperature required. Since this is the most important element of flow, to obtain reasonable accuracy, possibly a dozen or more points will be required within a temperature range of 20 deg. to obtain a curve that will accurately represent the viscosity for the actual temperature of the liquid flowing in the line.

We can see from an inspection of Equation (5) that B^n/N^n is the average discharge through each of the lines if all are of the same exact inside diameter, or M/N^n is the equivalent length of a single pipe line having the same values of the discharge and friction head, as that of a system of N number of parallel lines of the same exact inside diameter of pipe D.

The equation of the equivalent length of a single line having the same friction head and discharge may be written as

$$M_1 = \frac{M}{N^n} \quad \ldots\ldots\ldots\ldots \quad (8)$$

When all the lines in a system of parallel lines are not of the same exact inside diameter, we must compute for each pipe size its equivalent number of lines of a chosen diameter, then their sum is the equivalent number of lines N for the chosen size of line D in the station district, or if there are one or more gate plants between the two pumping stations, this sum will be the equivalent number of N lines for one of the sections. A section as here referred to, is the distance between the pumping station and the gate plant or the distance between two gate plants.

The derivation of Equation (10) may be seen from the transposition of Equation (4), solving for the discharge.

$$B = \sqrt[n]{\frac{2gbD^{(2n+x)}}{Ab\,K^w\,M}} \quad \ldots\ldots\ldots \quad (9)$$

From an inspection of Equation (9), it can be seen that for a given length, head, and viscosity, the discharge B varies directly as the $\frac{2n+x}{n}$ power of the diameter.

The equation of the equivalent number of lines of a given diameter equal to any chosen size of pipe may be written for each line:

$$N_1 = \left(\frac{D_1}{D_0}\right)^{\frac{2n+x}{n}} \quad \ldots\ldots\ldots \quad (10)$$

in which:

D_0 = the chosen diameter for computing the equivalent number of lines in the system of parallel lines

D_1, D_2, etc. = diameter of each of the parallel lines

N_1, N_2, etc. = number of pipes of the chosen diameter D having the same carrying capacity and friction head as that of the corresponding pipes of D_1, D_2, etc., diameter.

Now if $N = (N_1 + N_2 + N_3 \text{ etc.})$ then Equation (8) may be written:

$$M_1 = \frac{M}{(N_1 + N_2 + N_3, \text{etc.})^n} \quad \ldots \quad (8a)$$

as the complete equation of the equivalent length of a given size of line for a section of parallel lines of various pipe sizes.

All the formulae thus far presented are for each regime of flow, i.e., streamline and turbulent. It is now desirous to know just what values to assign to the four unknown factors b, x, n, and w, which must be obtained experimentally.

Streamline Flow

For streamline flow these four factors are fairly well known. Each experimenter of record seems to have adopted the curve of Poiseuille (1842) experiments, as representing the losses that may be expected when dvy/z is less than 2000, or when B/DKN is less than 91. The relations:

$$\begin{aligned} \log B/DKN &= 2.6548649 + \log dvy/z \\ &= 2.5437124 + \log Dv/k \\ &= 3.6228936 + \log dv/k \end{aligned}$$

are now established, as all reference following this statement will be to the argument B/DKN.

Between $B/DKN = 91$ and 112 the flow may be either streamline or turbulent, depending upon whether the streamline flow is being gradually increased or whether the turbulent flow is being gradually decreased.

The experimental values of the four factors here presented for streamline flow, were derived from the experiments of others; however, they seem to give fairly accurate results when the value of the argument B/DKN is below about 80.

$$\begin{aligned} b &= 0.0006889 \\ x &= 2 \\ n &= 1 \\ w &= 1 \end{aligned}$$

$$\left(\frac{2n+x}{n}\right) = 4$$

While these experimental values cannot in any sense of the word be classed as having any semblance of scientific value, they must continue to serve until petroleum pipe line engineers awaken to the fact that the rule-of-thumb methods now in use in pipe flow computations must cease, and do their part in making very careful experiments and give to the profession the details of each individual experiment that is worthy of publication, instead of developing another curve by using their own experiments, together with other questionable data as has been done time and time again.

Turbulent Flow

There are so many conflicting curves now in the Hydraulic literature, each purporting to give the results of experiments, that the writer has long since concluded all can be wrong and it is not very likely that any have the earmarks of scientific value.

Each has been substantiated by one or more pipe line engineers, yet they give results varying between wide limits.

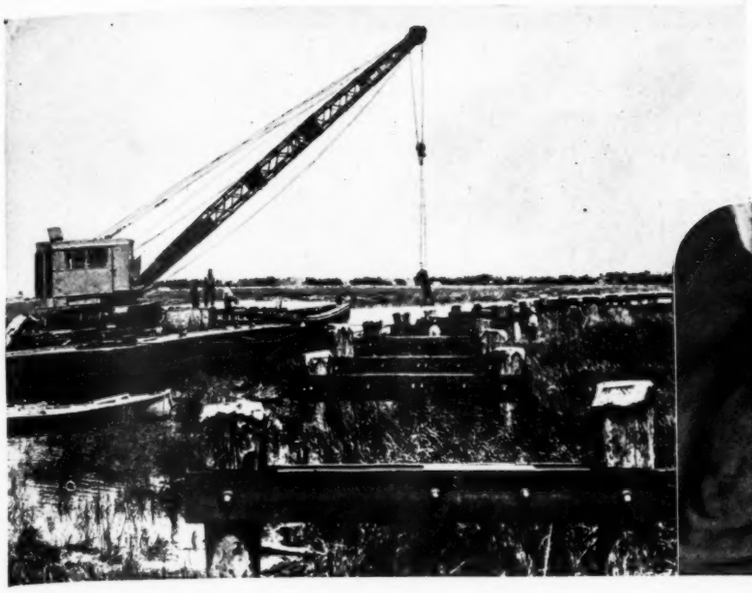
The writer has prepared Fig. 1, giving only a few of the most popular curves now frequently referred to in the Hydraulic literature. To give a complete history of the development and substantiation of each curve would require too much space at this time; however, you may be assured that each one came into existence highly recommended.

CORRECTION. Please note that Equations (1) and (2) in last month's article (p. 76) should read:

$$h = \frac{blk^w v^n}{2gd^x} \quad \ldots\ldots\ldots \quad (1)$$

$$h = \frac{f\mu l v^2}{2gd} \quad \ldots\ldots\ldots \quad (2)$$

EDITOR'S NOTE: Discussion on Turbulent Flow will be continued next month.



Two 10-in., one 14-in., and one 6-in. lines were laid on this trestle. Insert shows close-up of Multi-Flame Lindeweld Head in action.

Pipe Lines that couldn't fail and didn't . . . *with Lindewelding**

OVER the wastes and swamps of the Deltas of the Mississippi River, pipe lines had to be laid for a sulphur plant. Failure was unthinkable! Once laid, these lines had to stand up . . . without leakage or troubles that would jeopardize operation of a costly investment. This was the exacting demand that had to be met . . . even though piling for the trestles to support the line would sink 30 feet of its own weight.

Only one method of joining the piping for these lines could meet such brutal specifications. Lindewelding was the answer. From a past record of thousands of miles of pipe lines laid under all sorts of handicaps, Lindewelding had proved itself the type of jointless construction that would stand the gaff.

Lindewelding was used to install two 12 in. water lines, one 6 in. oil line, and one 14 in. gas line over miles of trestle. In addition, eight miles of 6 in., 8 in. and 10 in. lines were installed in the sulphur field running from the plant to the wells and other points. After installation, these lines were tested under 200 lb. water pressure . . . *without a leak!*

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*Lindewelding is a new method of oxy-acetylene welding developed by the Linde engineering and research organizations. This method requires less oxygen, less acetylene and less welding rod. Welds can be completed in less time. Yet Lindewelding involves only a special flame adjustment and a "back-hand" technique, together with Oxweld No. 24 Lindeweld Process Welding Rod. When circumstances permit, the Multi-Flame Lindeweld Head can be used to increase further the speed of Lindewelding. This head costs $7.75. Lindewelding is consistently saving 15 to 40 per cent in welding time, rods and gases.

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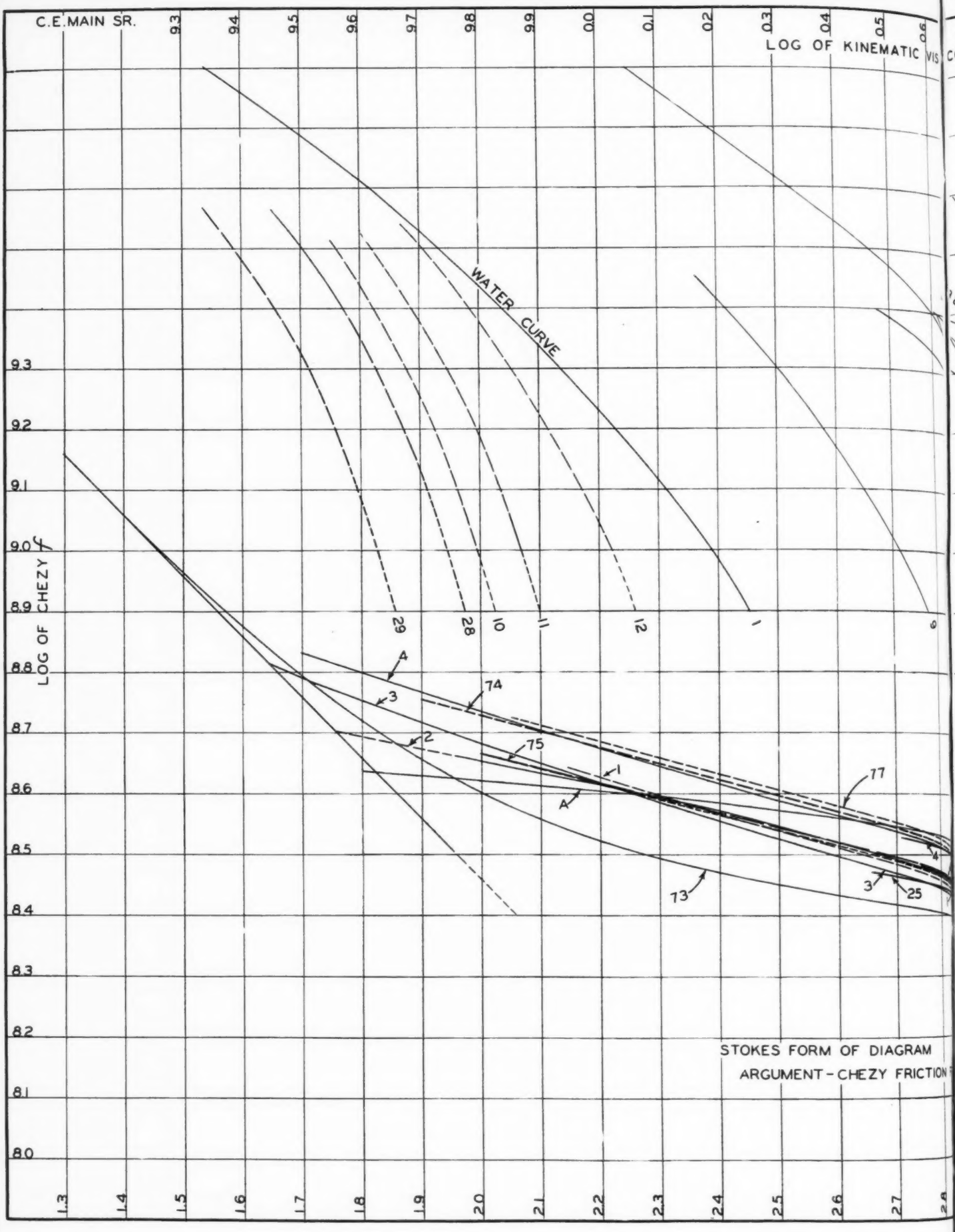
C.E. MAIN SR.
LOG OF KINEMATIC VIS
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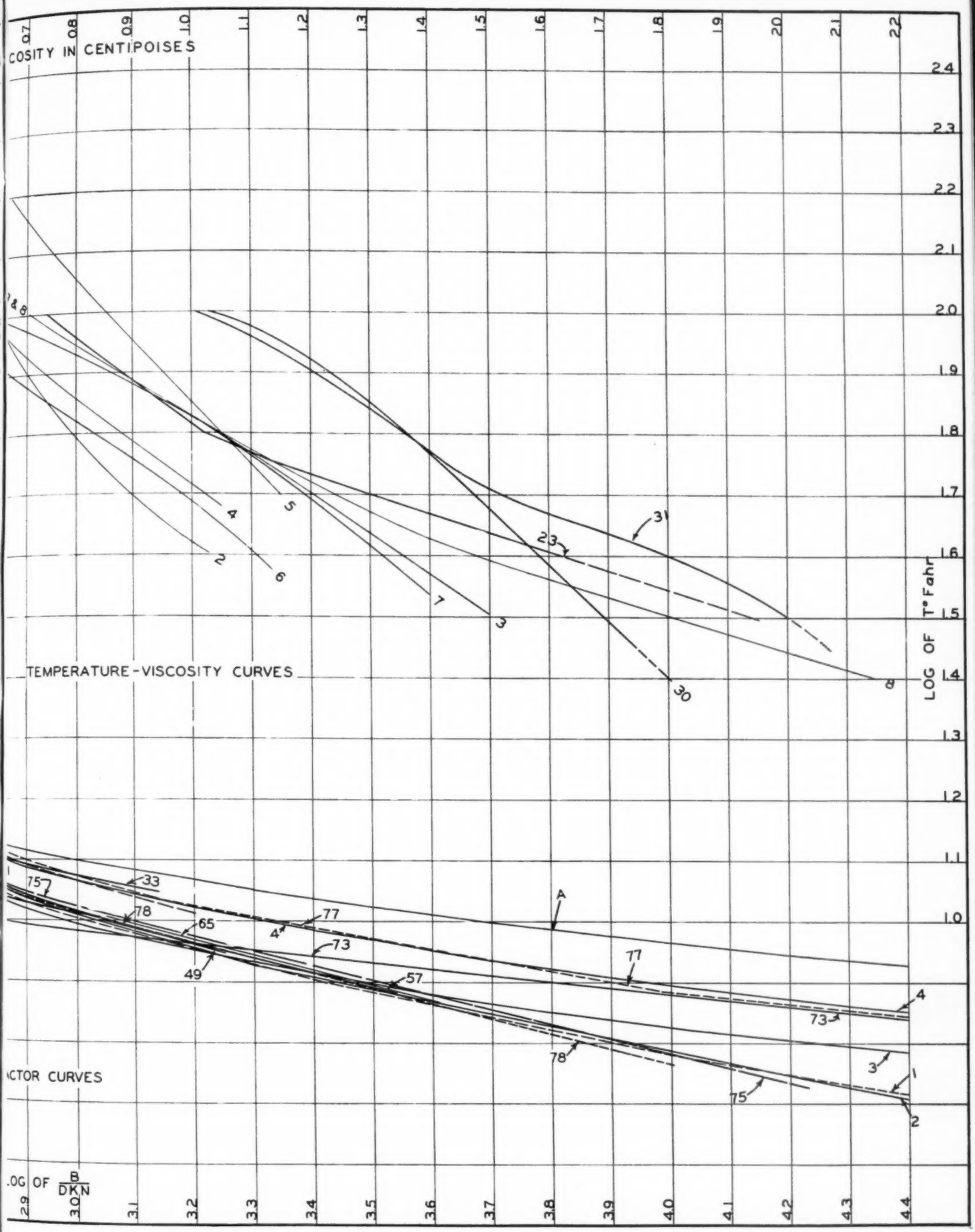
STOKES FORM OF DIAGRAM
ARGUMENT - CHEZY FRICTION


COSITY IN CENTIPOISES
TEMPERATURE-VISCOSITY CURVES
LOG OF T° Fahr
ACTOR CURVES
OG OF B/DKN

Elements of Applied Petroleum Refining

By W. L. NELSON
Consultant*

Article XXII

METHODS OF CONDUCTING VAPORIZATION

THE fundamental relations between the composition of a liquid and the vapor from it, as discussed in Article XXI, July, are practiced commercially in the petroleum industry in three ways, namely: in a shell still in batch operation, in a battery of shell stills, or in a pipestill.

Batch operation conducted in a shell still is almost a direct duplication of most of the distillation operations that are conducted in the laboratory. A shell still without a fractionating tower corresponds to an A.S.T.M. distillation flask, and a shell still with a tower corresponds to a Hempel distillation equipment or more elaborate equipments in which the vapors from the flask are fractionated by a column packed with beads, chain, etc. This manner of heating and vaporizing involves a large capital investment and is no longer used for the main distillation operations. However, in redistilling 'slop' stocks, solvents, and specialty products that are manufactured in small quantities, the batch shell still is still used in many refineries.

A major disadvantage of batch shell still distillation is the fact that the operation is not continuous. Time is required for cooling, discharging, and heating, and the thermal efficiency is poor because much of the heat in the brickwork and setting is lost during each cycle of operation. Refiners soon recognized the advantages of continuous operation and adopted the so-called continuous battery of shell stills. A series of shell stills are arranged so that the oil can be continuously discharged from one to the next by gravity, by steam jets, or pumps. Each succeeding still is maintained at a higher temperature than the one before it and in this way an evolution of constant composition material issues from each still as a vapor and the residue liquid progresses to the next still. Such an arrangement is shown diagrammatically in Fig. 44. However, there are many other suitable ways to arrange a battery of shell stills, and each refiner has adopted a system that is best fitted for his particular needs. Although shell stills are not so economical or effective as pipe stills they are still widely used. Doubtless the reason for the continued use of shell stills is the large investment that they represent.

*Professor of Petroleum Refining—University of Tulsa.

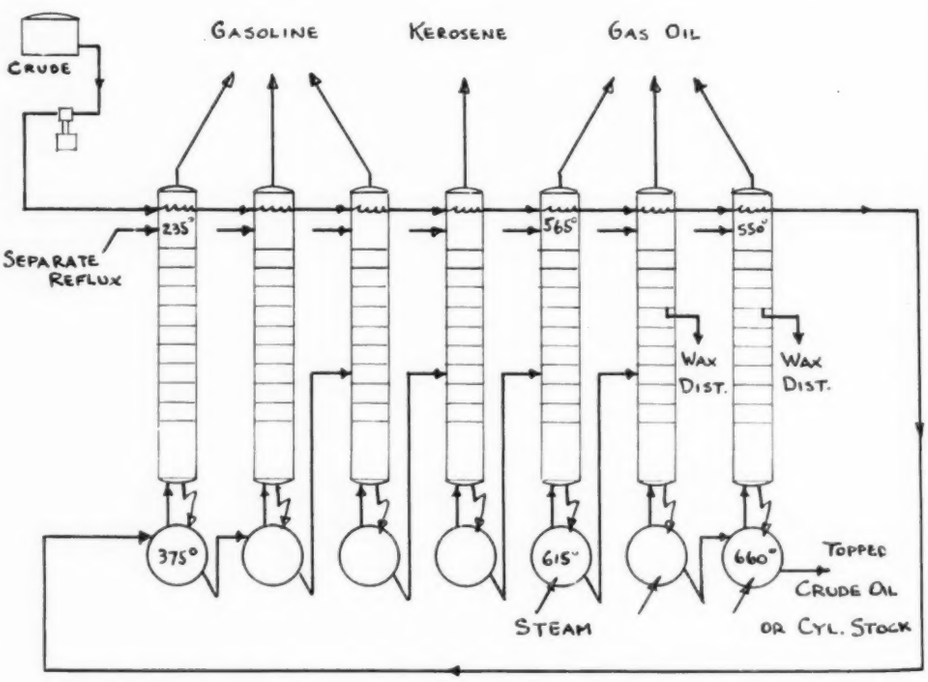


Fig. 44. Diagram of a battery of shell stills.

The pipe still or tube still is the most recent development and nearly all the plants that are being installed today are of this type. The operation differs from the above because the entire liquid charge stock is heated to the final high temperature without allowing the vapors to separate from the remaining liquid. The general arrangement of the equipment is shown diagrammatically in Figs. 13, 14, 16, 17, 19, and 21, in previous articles of this series.

From the standpoint of vaporization that main difference in the three aforementioned methods of vaporization is the fact that flash or equilibrium vaporization may be practiced in the pipe still and cannot be practiced in shell stills.

EQUILIBRIUM FLASH VAPORIZATION

When a pure material is heated its energy content increases and at some high temperature the energy content is high enough to cause the material to vaporize. The same changes tend to take place when a mixture is heated except that energy may be transmitted from one material to another because of their proximity in the mixture. Thus, the hydrocarbons that tend to be vaporized at a low temperature lose part of their energy content to the high-boiling molecules

and fail to vaporize at their respective boiling-points. This is illustrated for a two-component system in Fig. 43, Article XXI, July, 1935. Whereas pure butane boils at 146 deg. fahr. at 100 lb. pressure, a mixture containing 60 per cent butane does not start to vaporize until a temperature of 170 deg. fahr. is attained.

The same phenomenon occurs with more complex mixtures but it is usually impossible to show exact compositions because the mixture cannot be analysed. The customary way to indicate the equilibrium vaporization properties of a mixture is by means of the flash vaporization curve, examples of which have been given in Article I, Figs. 2, 3, and 4, November, 1933. These curves show the amount of material that will be vaporized for various temperatures if the mixture is heated in a closed coil as in a pipe still, or in other words, by flash vaporization. Inspection of Curve 6, Fig. 2, shows that 70 percent of the crude oil can be vaporized at 700 deg. fahr. by flash vaporization whereas a temperature exceeding 790 deg. fahr., is required if the distillation is conducted in a shell still with a fractionating tower. The temperature of 790 deg. fahr. is the vapor temperature at the top of the fractionating tower and hence even a higher temperature than 790 deg. fahr. (perhaps 850 deg. fahr.) is necessary in the shell still itself. This difference in temperature does not arise in the case of flash vaporization because the liquid and vapor are the same temperature as they issue from the pipe still.

A comparison of the liquid temperatures that are necessary by various methods of distillation are indicated in Fig. 45. The curves are for a pressure distillate when distilled by flash vaporization, an A.S.T.M. distillation (no fractionation), a Hempel distillation (some fractionation), and a true boiling-point distillation (good fractionation). The much lower temperature that is required by flash vaporization is clearly evident. The same general difference in temperature occurs for all mixtures, and for high-boiling materials the lower temperature by flash vaporization is of great importance. In fact, flash vaporization permits the distillation of some high-boiling materials such as asphalt or reduced crude oil, that could not be distilled by shell still distillation without serious decomposition.

The use of a single shell still and the use of a pipe still are clear-cut cases of batch vaporization and of flash vaporization, but the continuous shell still battery is a cross between the two. In a shell still battery the liquid that flows from one still to the next undergoes flash vaporization to some extent because it is suddenly heated by the body of oil in the next still. However, true flash conditions do not exist because the body of high-boiling material in the next still absorbs some of the energy content of the low-boiling materials in the feed, and to some extent suppresses the vaporization of them. In other words, flash vaporization occurs in the presence of an inordinately large amount of high-boiling material. The more stills that are used in the battery the less the flashing effect and the operation approaches simple batch vaporization if a very large number of stills are used.

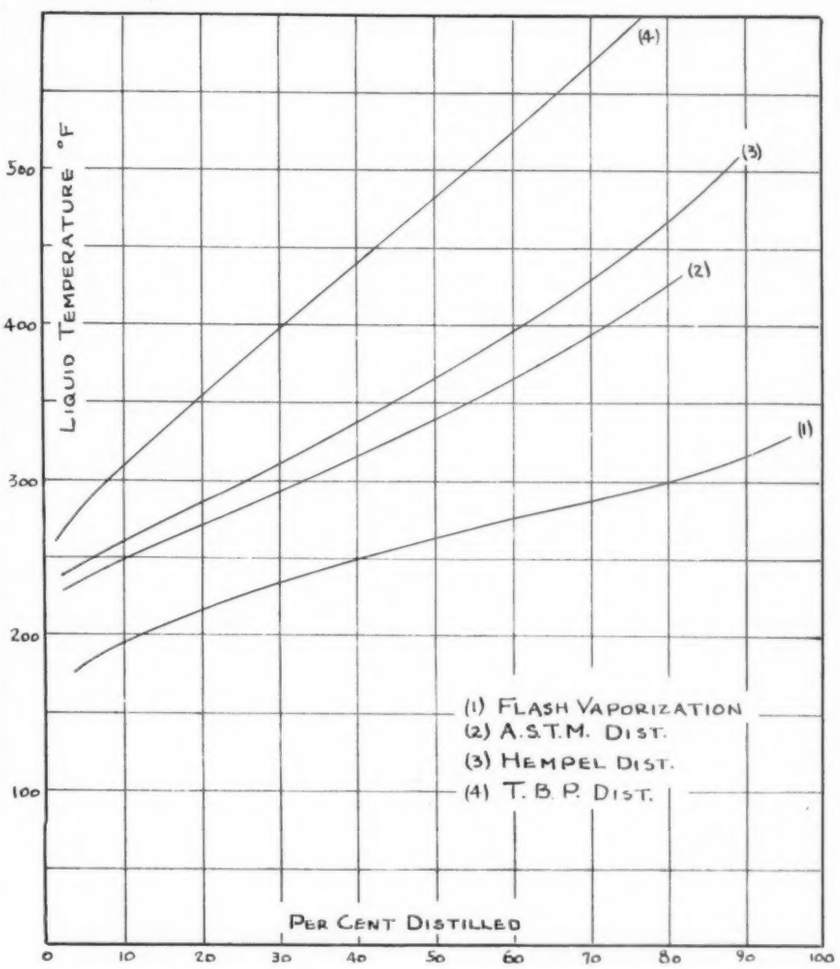


Fig. 45. Liquid temperature curves for several kinds of distillations.

OBTAINMENT OF FLASH VAPORIZATION DATA

The ideal way to obtain flash data is to distill the material in the laboratory in equipment that simulates pipe still operation[1]. However, these laboratory operations are expensive and it is common practice to compute an approximate flash vaporization curve from the A.S.T.M. or true boiling-point distillation curves. Fig. 46 shows a correlation of Flash Vaporization curves and A.S.T.M. distillations. The flash vaporization curve that is obtained by this correlation is a straight line and it is not entirely accurate because the flash curve has a curvature just as the A.S.T.M. distillation curve has a curvature. However, the curvature is not so pronounced in the flash curve as in the A.S.T.M. distillation and hence the inaccuracy is not great.

EXAMPLE 34. *Construction of Flash Vaporization Curve.* The A.S.T.M. distillation of a pressure distillate is:

Per Cent Distilled	Vapor Temp. Deg. Fahr.
5	124
10	168
20	230
30	283
40	327
50	365
60	398
70	429
80	461
90	501

Fig. 46. Correlation of A.S.T.M. distillation curve and flash vaporization curve.

Compute the Equilibrium Flash Vaporization Curve.

The curve is constructed by means of the relation between the 50 percent boiling-points, and by means of the slopes of the two curves. The slope is expressed as degrees rise in temperature for a one percent increase in the amount vaporized, or as degrees percent. The slope is always taken between the 10 and 70 percent points. The relation between the 50 percent boiling-points is given by the lower and left scales, and the relation between the slopes by the upper and left scales.

The 10-70 slope of the A.S.T.M. distillation curve is:

$$\frac{429-168}{70-10} = 4.35$$

The 50 per cent boiling-point of the A.S.T.M. curve is 365.

The slope of the flash curve (Fig. 46) is 2.68.

The 50 percent boiling-point of the flash curve is obtained from the curve (Fig. 46) for slopes of three to five. The 50 percent boiling-point is 330.

The flash curve can then be drawn because one point (the 50 percent point) is known and the slope of the line is known.

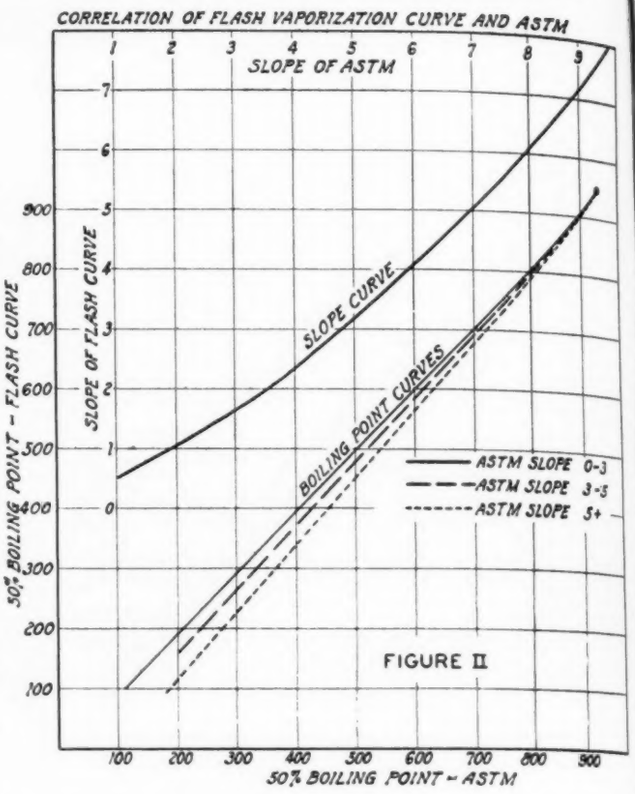
As illustrations, the 100 percent, the 0 percent, and the 76 percent points will be computed.

100 percent point	$330 + (50 \times 2.68) = 464$	deg. fahr.
0 percent point	$330 - (50 \times 2.68) = 196$	deg. fahr.
76 percent point	$330 + (26 \times 2.68) = 399.7$	deg. fahr.
or	$196 + (76 \times 2.68) = 399.7$	deg. fahr.

All these points need not have been computed because only two points (say 50 and 100 or 50 and 0) are necessary to draw a straight line.

QUESTIONS

1. What are the three common commercial methods of vaporization?
2. Explain why a lower liquid temperature is required for flash vaporization than for any other method of vapor formation.
3. Compute the temperature required to flash ten percent of the distillate studied in Example 34.
   Answer: 222.8 deg. fahr.



4. How much material will be vaporized by flash vaporization of the oil studied in Example 34, at a temperature of 325 deg. fahr.?
   Answer: 48.1 percent.

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Road Engineers Suggest Use of Refining Wastes in Building Low-Cost Highways

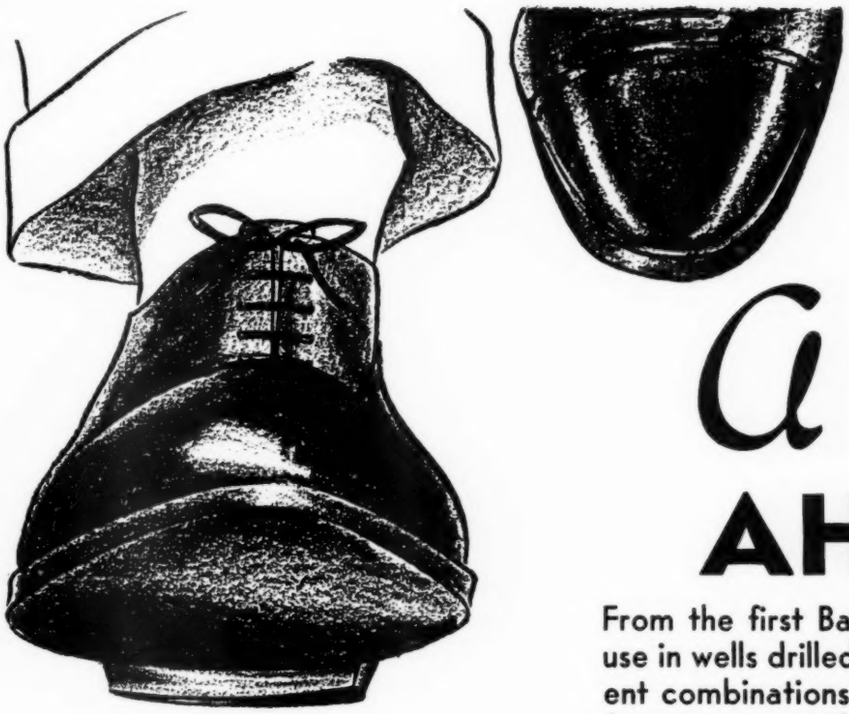
A plan to promote conservation of natural petroleum resources by building economical highways is being placed before highway commissioners and engineers by the Low Cost Roads Association of Kansas City, Missouri, according to information reaching the American Petroleum Industries Committee.

The plan, based upon complete utilization of all products of petroleum, calls for the use for highway improvement of the asphalts and road oils left as residual products in the manufacture of motor fuels and lubricants.

"The refining process that produces gasolines and lubricating oils also produces road oils and asphalts," it was explained by Secretary G. E. Everett. "When the motorist can consume petroleum products in his car driving over a highway paved with petroleum products, we have true conservation of petroleum resources. This plan is particularly effective because taxes paid on the gasoline consumed on each highway would more than meet the cost of paving with the by-products of gasoline manufacture.

"Improvements in highway design have made it unnecessary to spend $25,000 a mile for narrow slab pavement. Wider, and safer, highways can be built with petroleum surfacing for $5,000, or less, per mile. The farmer can be taken out of the mud with oiled roads costing $1,000, or less, per mile.

"The petroleum industry has submitted to burdensome taxation of its major products to finance good roads. Motorists have paid more than $4,000,000,000 in gasoline taxes in the last 15 years, yet only about 300,000 miles of road have been even improved. For that amount 3,000,000 miles of economical highway could be built and the limited and dangerously congested mileage of our present road system be expanded and made safe."



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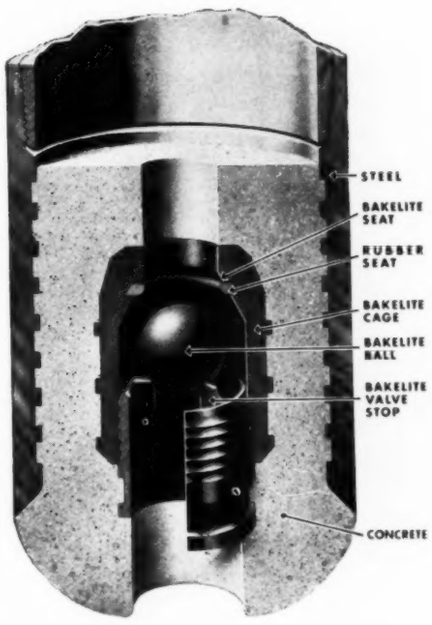
• VALVE EFFICIENCY

Ample passageway is provided through the valve assembly of Baker Cement Equipment; and the buoyant Bakelite ball (which floats in rotary mud or cement slurry) instantly double-seals against rubber backed by Bakelite at the first reversal of pressure.

• STRENGTH

Any unit of Baker Cement Equipment possesses Strength greater than the collapsing strength of the casing upon which it is used.



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Installing Dresser couplings on the line several miles west of Port Isabel

By CHARLES J. HOLLAND

Departure in Pipe Line Construction

WITH the comparatively recent discovery and rapid development of the Sam Fordyce oilfield in the extreme southwestern end of Hidalgo County there has come an increasingly urgent requirement for a less expensive means of transport for the crude than is afforded by railway tank cars. Though several individuals and firms studied the situation and prepared plans, it remained for Murchison and Closuit, Inc., of Dallas, Texas, to consummate a comprehensive program that is now in process of execution, as the following account reveals.

For the purpose of building and operating an integrated system composed of a pipeline, tidewater terminal, and refinery, T. Frank Murchison and Ernest M. Closuit have organized and hold controlling interest in three separate companies, the Valley Pipeline Company, the Port Isabel Terminal Company and the Coastal Refineries, Inc. Associated with them and more particularly in connection with the terminal and refinery are C. L. Rowsey and Harris Melasky of Taylor, Texas. The purpose of this article is to give a brief description of the pipeline: In a subsequent issue, special reference will be made to the terminal and refining facilities, construction work on which is only just now beginning.

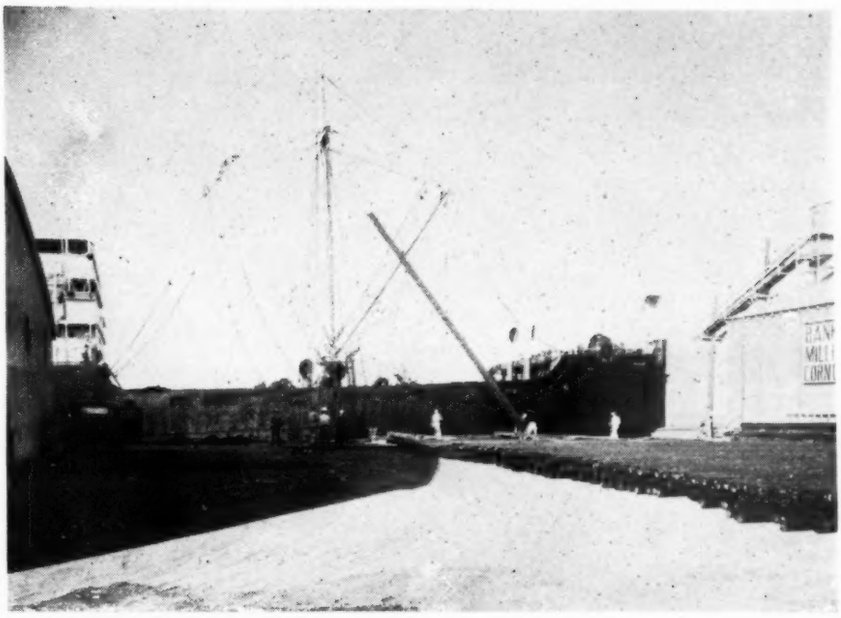
The general route of the pipeline begins in the center of the Sam Fordyce pool and terminates at Texas' newest deepwater seaport, Port Isabel—opened to sea-going vessels on August 1, 1935; also at Port Isabel will be the terminal tanks and the refinery. Work on laying the pipeline was begun on August 8 and, barring unforeseen developments, the line will be filled with crude oil by September 15.

The line will be of 5½-in. O.D. plain-end pipe of random lengths averaging 45 ft. each. The total distance covered will be 88 miles, from sea level at Port Isabel to 180 ft. above sea level at Sam Fordyce.

Only one pumping station will be installed at present. Situated at approximately the oil pool's center, it will consist of one Worthington Diesel engine horizontal pumping unit, 85 hp., duplex power-driven, 3¾-in. x 10-in., direct connected through flexible coupling to engine and rated at 5000 bbl. per day of crude at 850-lb. gauge pressure. With the present field allowable of only 2800 bbl. per day, this station will more than meet all delivery requirements. Midway along the line provision is being made for the installation of a second pumping unit, exactly similar to the first, when the field's allowable requires it and also with consideration to the probable extension of the pipeline to serve other pools, now of relatively small size, in the territory of northern and southern Starr County.

Storage in the field being erected consists of one 20,000-bbl. and one 55,000-bbl. tank.

Couplings piled in the warehouse prior to transportation to the job



Unloading the first cargo of materials at Port Isabel

Construction of the line is under contract to the Fredell Construction Co. of Denver, with Oscar Fredell on the ground in active charge.

All steel storage is being supplied by the Wyatt Metal and Boiler Works of Dallas and Houston, who also hold turn-key contracts for erection of terminal and refinery. The entire undertaking has been arranged for through the Republic Supply Company and the pipe was shipped from the Republic steel mills in Pennsylvania via rail to Baltimore and thence by water to Port Isabel. Parenthetically, it is worth noting here that this cargo of pipe was the first incoming shipment to arrive at the new port. An accompanying photograph gives a view of the pipe stacked along shipside at the Port Isabel municipal docks.

The line is being laid in a 30-in. bottom ditch (giving a 24-in. coverage), dug by three ditching machines working simultaneously, all going from east to west and averaging 2½ to 3 miles per day. Stringing, connecting, laying, and filling-in of the line is proceeding at the same rate. Accompanying photographs, taken some six to ten miles west of Port Isabel, show these activities.

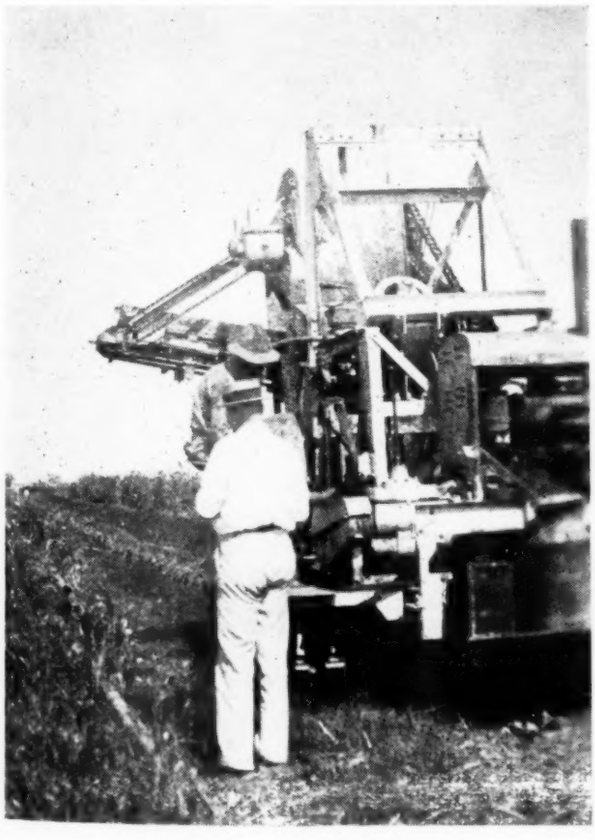
The line is being coated with an asphalt paint, for corrosion abatement, manufactured by the A. C. Horn Company of Houston. Sometime in the near future the pipeline management expects to make a series of commercial experiments in the Valley country for determining the best and most suitable types of soil-corrosion paints and other pipeline coverings.

The corrosion problem, caused by the high moisture content of the soil, was one of several others of importance in connection with design and construction of the line. There were no experience data to go by since the soil conditions are not at all the same as are found in other Texas coastal areas where pipelines have been laid. Another problem encountered involves the numerous irrigation and drainage ditches, highways, and railways necessary to be crossed along the route of the line, under each of which a tunnel has to be dug. A third unusual element concerns the great number of right-of-way easements per mile that had to be obtained, due to the extremely small subdivided tracts of most of the Lower Rio Grande Valley country.

One of the most interesting items about the Valley Pipe Line Company's project has to do with the pipe joints. Dresser couplings are being used, and in these days of high-speed arc welding it is indeed a rather unique sight to witness this part of the construction job. Charles Davis, representative of the S. R. Dresser Mfg. Co. of Bradford, Pa., is on the job to see that everything Dresser-wise is in order. He pointed out that though many long and high-pressure gas lines have successfully employed Dresser couplings, this is the first oil pipeline of such length, size, and operating pressure to use them for the entire job—not quite entirely, however, for at all bends the joints will be welded; this because of the relatively short length of the coupling there would be some risk of the line pulling apart. Dresser couplings in this instance serve a dual purpose, being expansion joints as well as pipe couplings. Expansion is automatically provided for because of the resiliency of the rubber elements contiguous to the outer surface of the pipe. The natural resiliency of the rubber allows for a rolling motion whereby the pipe joints are free to move without leakage and for a sufficient distance to take care of all ordinary temperature changes.

Though the comparative first costs of welding and Dresser couplings very closely approach each other, the Valley Pipe Line Company made its decision in favor of the latter because of ease and rapidity of installation, repair, replacement and, some day if advisable, the quick and entire removal of the line to another location.

H. H. Hensley is general manager of the Valley Pipe Line Company.



One of the ditchers being used in constructing the line

Institute Members Urged to Make Early Reservations for Annual Meeting in Fall; Various Committees Named

Hotel reservations already are being made for the 16th annual meeting of the American Petroleum Institute scheduled for November 11, 12, 13, and 14 in the Biltmore Hotel at Los Angeles, California.

C. E. Olmsted, of The Texas Company, chairman of the committee on hotel reservations, has asked members and others planning to attend the meeting to make their reservations as early as possible so as to permit the committee to provide adequate accommodations.

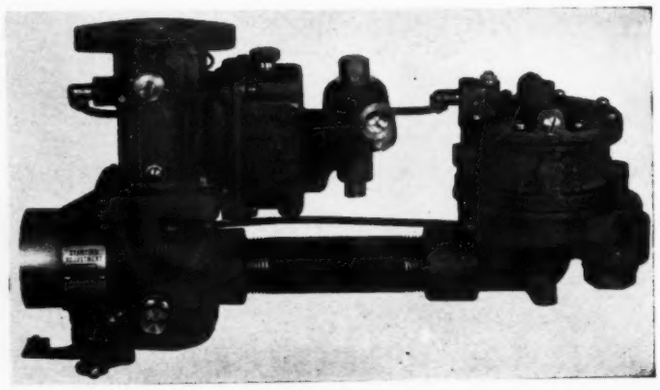
Reservations are being filed with Earle L. Southgate, California Oil and Gas Association, 1217 Associated Realty Building, Los Angeles, California.

In addition to Chairman Olmsted, the members of the committee on hotel reservations are: L. P. St. Clair, Union Oil Company of California; C. S. Jones, California Oil and Gas Association; and J. A. Crawford, The Republic Supply Company of California.

C. S. Jones, executive vice-president of the Rio Grande Oil Company, Los Angeles, California, has been appointed general chairman of the committee organization making local arrangements for the meeting. Other committee chairmen include: Finance, R. D. Matthews, Union Oil Company of California; reception, W. C. McDuffie, Richfield Oil Company of California; hotel reservations, C. E. Olmsted, The Texas Company (California); banquet, W. L. Stewart, Jr., Union Oil Company of California; transportation, J. U. Stair, Shell Oil Company; publicity, H. E. Britzman, Rio Grande Oil Company; golf, J. A. Jones, Associated Oil Company; at large, W. L. McLaine, General Petroleum Corporation of California; and Wildcats, J. A. Dunn, National Supply Company of California. Entertainment will be in charge of the Wildcats, a social organization.

Included among the committees is a general committee of 100 prominent oil and supply company executives representing all phases of the industry. An advisory committee also has been appointed, with R. E. Collom of the Continental Oil Company as chairman. Members are: Lionel Barneson, Bankline Oil Company; S. Belither, Shell Oil Company; A. C. Dieriex, Honolulu Oil Corporation; D. S. Faulkner, National Supply Company of California; E. B. Gilmore, Gilmore Oil Company; P. M. Gregg, Union Oil Company of California; S. A. Guiberson, Jr.; Oscar R. Howard; W. F. Humphrey, Associated Oil Company; K. R. Kingsbury, Standard Oil Company of California; L. H. Keim, Oil Well Supply Company; W. H. Morgan, R. R. Bush Oil Company; W. C. McDuffie, Richfield Oil Company of California; A. B. MacBeth, Southern California Gas Company; A. C. Mattei, Honolulu Oil Corporation; S. B. Mosher, Signal Oil and Gas Company; T. A. O'Donnell; P. H. O'Neil; William Reinhardt, Kettleman North Dome Association; F. C. Ripley, Chanslor-Canfield Midway Oil Company; C. C. Stanley, The Texas Company; W. L. Valentine, Fullerton Oil Company; and H. L. Westbrook, Belridge Oil Company.

Members of the executive committee are: General Chairman Jones; R. A. Broomfield, Barnsdall Oil Company; J. A. Crawford, Republic Supply Company of California; Ralph B. Lloyd, The Lloyd Corporation; C. E. Olmsted, The Texas Company (California); L. P. St. Clair, Union Oil Company of California; and A. L. Weil, General Petroleum Corporation of California.



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Bart W. Gillespie Joins Sales Force MacClatchie Manufacturing Company

MacClatchie Manufacturing Company, Compton, California, announce the appointment of Bart W. Gillespie to their sales force. Gillespie served as an officer in the engineering corps during the world war, after which he went to Mexico where he was engaged in geological work. Returning to the United States he went to work in the oil fields and spent ten years with one of the well known core drilling companies.

Four Wheel Drive Auto Company Celebrates 25th Anniversary

The Four Wheel Drive Auto Company, Clintonville, Wisconsin, celebrated its 25th anniversary with the announcement by Walter A. Olen, president and general manager, of plans for the enlargement of the selling and advertising activities.

"Total business from all sources for the first six months of this year," he said, "has increased 70 per cent over total business for the same period last year. We face the beginning of our second 25 years with plans for added impetus to our sales and advertising program. We have emerged from the recent down swing of the business cycle with an improved product and splendid business prospects. Never in the 25 years of operation has the FWD plant been shut down because of strikes, labor troubles or lack of orders.

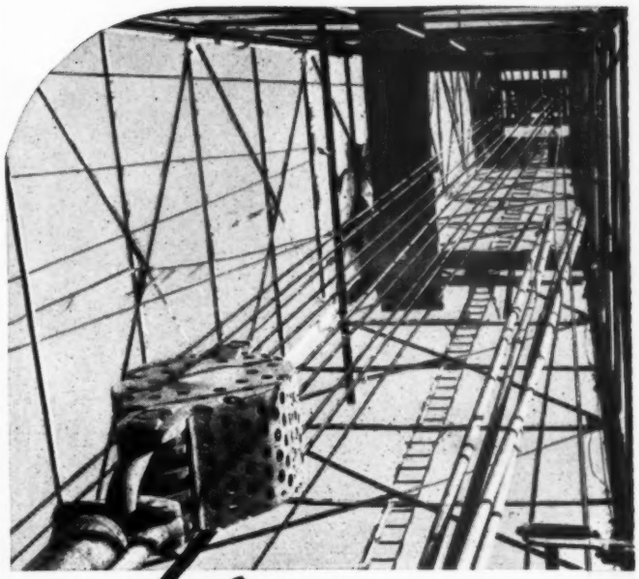
"We will try not only to increase our sales but will endeavor to do further research in safety methods as a contribution to the automotive industry in the reduction of the enormous list of casualties due to motor accidents."

FWD manufactures four wheel drive trucks exclusively and the past year has seen the development of several new models, including the Model HS, one-and-a-half-ton truck. The company is now making 22 models of trucks.

Since the inception of business in 1910, Walter A. Olen, D. J. Rohrer, and Frank Gause, have been president, treasurer and secretary, respectively, of the company, without interim.

Lufkin Executives Complete Trip

W. C. Trout, president, Lufkin Foundry & Machine Company, and Mrs. Trout have just returned from a three weeks' vacation trip that carried them to Chicago, Cleveland and New York. At New York they were joined by A. V. Simonson, Lufkin's Export Representative, and Mrs. Simonson and from this point toured the New England States.



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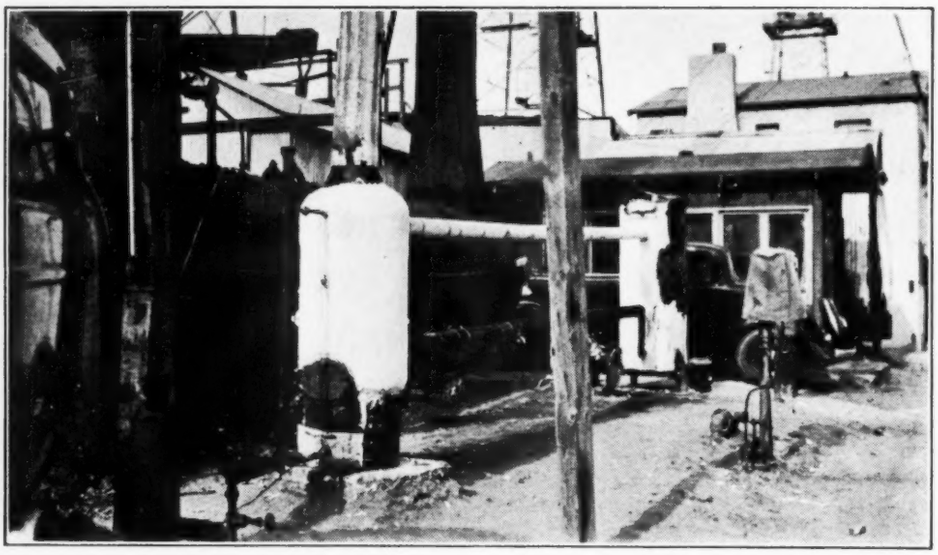


Type of heater used by many large and small producers in the Venice field for treating cut oil.

By

J. C. ALBRIGHT

Small Individual Heaters For Treating Cut Oil at Wells

OIL produced in the Venice field on the ocean front in the Los Angeles Basin—sometimes called Playa del Rey—is cutting so excessively that many of the smaller producers of crude in that area, as well as the larger companies who have wells more or less isolated, have recently installed miniature heaters to be used in conjunction with some sort of treating compound in order that the heavily cut crude can be cleaned and shipped as pipe line oil, without the severe penalties and recurring rejections by the gathering companies because of b. s. & w. These units, except for slight variations, are all of similar construction and their operation depends upon the characteristics of the emulsion, the amount of fluid pumped through them, and the ideas of the individual operator.

The principal item in assembling and constructing these oil heaters is the boiler or vessel in which the heat is generated. The area in which this field is situated being within the corporate limits of the City of Los Angeles, severe restrictions, because of fire hazards, have been placed on the producer when operating a steam generating plant that carries a pressure in excess of 15 lb. per sq. in. gauge. The restrictions placed upon him, determined by city ordinance, include also the heating of his oil in bolted tankage. In order to comply with regulations, he must either employ regularly licensed boiler firemen to operate the high-pressure steam-heated treating plant or manage some way to dispose of his oil as it is produced from the well. Through the operation of this small low-pressure unit the ordinary pumper can clean the oil without difficulty.

These small treaters have two major units, one of which is the vessel in which the heat is generated, a small boiler of the upright or vertical type having a power output of from five to ten hp. when operated at its rated capacity. Many of these small boilers can be had by purchasing them from salvage concerns at various prices; and their purchase price largely determines the ultimate cost of the completed oil-treating unit. Once it has been obtained the boiler is mounted at a convenient point on the small cramped leases so that the gas from the drilling boiler fuel lines may readily be tapped or the lines of some industrial system may be utilized instead. In the Venice field, these small steam generating units have been mounted on concrete or brick foundations set near the ground level.

The other unit, which is the oil heater, is constructed from various size cylindrical pipe, usually about two ft. in diameter by five ft. in length, also set in a vertical position approximately 15 ft. from the boiler. The construction of the heater is similar to an ordinary heat-interchanger, having a flue or tube sheet welded in the lower end about six in. from the edge of the cylindrical pipe. Forty-eight—some have more, and others have less—1-in. pipes are welded to the tube sheet after perforating it with a regular pattern so the tubes can be inserted. Below the tube sheet and in the 6-in. chamber a dividing wall is placed extending downward toward the open end and is flush with the edges of the pipe. The head is also welded in position with an oil-tight joint between it and the dividing wall.

The upper end of the heater is also constructed with a tube sheet but no dividing wall is placed on it. A similar space is provided, as in the lower compartment between the tube sheet and the end of the pipe. Practically all these units are fitted with welded rims on the upper end so a bolted head may

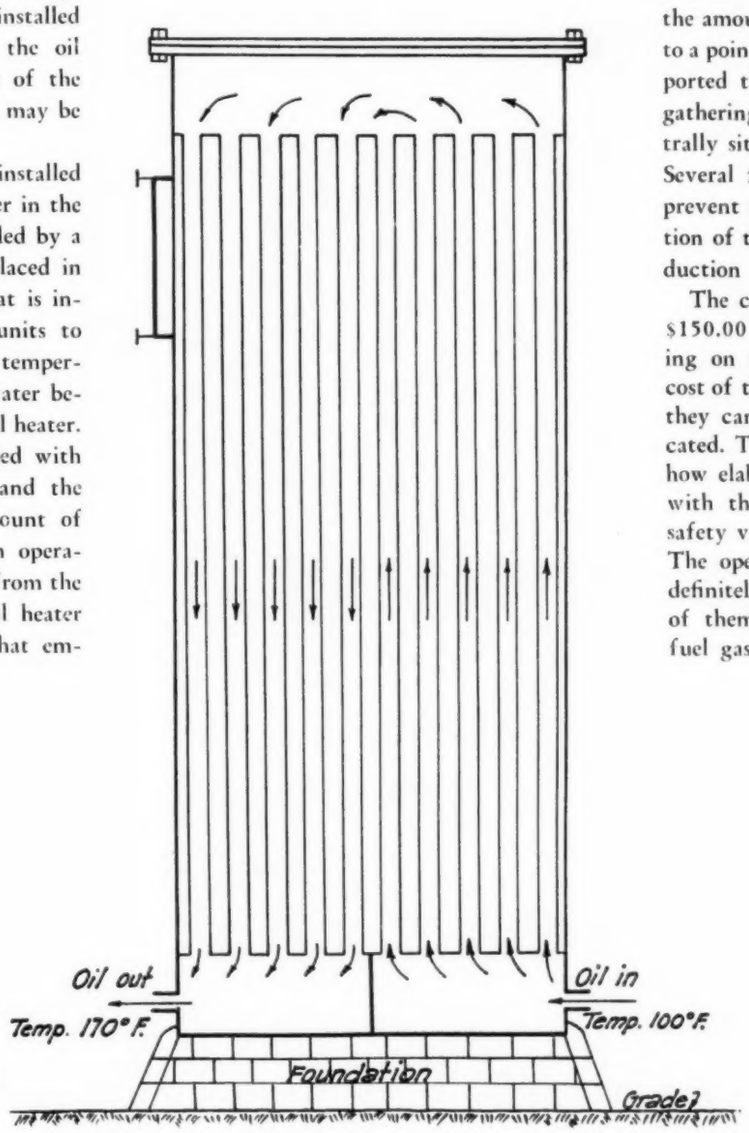
be attached when closing the unit, and to permit cleaning the tubes when they become fouled with sediment. The lower compartment of the heater section is fitted with two 3-in. connections placed opposite each other at the most distant point from the dividing wall. These connections permit the lead line from the tubing heater at the well to be attached to one, while the line continues from the one on the opposite side to the flow tank battery. A thermometer well is placed through a connection in the 3-in. tee on the outlet fitting leading from the heater to the flow tank.

Two 2-in. connections have been made in these miniature steam plants, one near the base and the other near the top. As they are invariably of similar construction, being fire tube boilers with the flues set vertically, the connections must be made at a point between the flue sheets. Connections (2-in.) are welded in the side of the oil heater nearest the miniature boiler in such a position that a 2-in. line may be fitted to the one at the top of the boiler and to the top connection on the heater. The lower connections on both units are utilized in a similar manner, with both lines joined at a convenient point by lip unions or bolted flanges. When completed, both units as well as the connecting lines are lagged with insulation (Johns-Manville 85 percent magnesia). Gauge glasses are installed on both the boiler and the oil heater so that the height of the water placed in the system may be determined.

A simple gas burner is installed in the combustion chamber in the base of the boiler, controlled by a pressure-reducing valve placed in the fuel line. A thermostat is included in some of the units to maintain a predetermined temperature on the circulating water between the boiler and the oil heater. Most of them are equipped with manual control only and the pumper regulates the amount of fuel by a hand valve. In operation, the water circulates from the boiler and through the oil heater in the same manner as that employed in the older automobiles, by thermosyphon action. Oil pumped from the well enters the base of the heater through one fitting and rises through one section of the tubes, returning to the base through the other section. The temperature at which the outlet stream is carried varies according to the characteristics of the crude and the ease with which the emulsion is broken down. The temperature on the heater is maintained by the amount of gas utilized in the boiler, transferred by the circulation of the water. By hand control, the temperature fluctuates to some extent, depending upon the rate at which the fluid is raised from the well. If the well pumps by heads, it is necessary to install a thermostat to care for diminished flow between the heads. The temperature employed by the majority of the operators of these small heaters averages about 160 deg. fahrenheit.

Various treating compounds are employed in breaking down the emulsion, all that used requires heat in excess of that originally in the oil when it is pumped from the producing zone. One well at which one of these units is being operated produces approximately 300 bbl. of fluid, cutting about 50 per cent. When the emulsified oil is passed through the heater, assisted by the treating compound, and allowed to settle in one of the lease flow tanks, the amount of emulsion is reduced to a point that the oil can be transported through the lines of the gathering company to the large, centrally situated dehydrating plants. Several factors are involved that prevent the complete demulsification of the oil, but the average reduction is to about 2½ percent.

The cost of these units is from $150.00 to $250.00 each, depending on the cost of material, the cost of the boiler, and how quickly they can be assembled and fabricated. The cost also depends upon how elaborately they are equipped with thermostat fuel controllers, safety valves, and pressure gauges. The operating cost has not been definitely determined because none of them has been equipped with fuel gas meters.



Cross-section of heater unit.

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TRADE LITERATURE

THE LUFKIN RULE COMPANY, Saginaw, Michigan, has issued its new General Catalog No. 12, describing and illustrating all lines manufactured by the firm, including precision tools, measuring tapes, rules, etc. A system involving the use of index arrows on the front cover and black markers on the edge of the book makes it possible to turn with ease and speed to any of the seven sections of the catalog.

A NEW CATALOG describing the Industrial Brownhoist Rope-reeve, Power-wheel, Lever-arm and Link-type buckets has been issued by the Industrial Brownhoist Corporation, Cleveland, Ohio. This is one of the most complete lines of buckets built. Sizes range from ½ to 15 yards capacity. Copies of the catalog will be sent upon request to those interested.

"MODERN BLOWOUT PREVENTION" is the title of an 8-page, 2-color booklet of Cameron Iron Works, Houston, Texas, just off the press. It presents the new Cameron "SDA" blowout preventer, one of the latest things on the market in well control, which features a new improvement in preventer packing methods and a much shorter preventer, yet one having a far more powerful closing means. The booklet tells the whole story of the "SDA" preventer, and shows how it combines with the new Cameron pressure-operated gate valve to offer most complete protection. A copy of this booklet is available upon request.

The General Electric Company, Schenectady, New York, has available for free distribution several bulletins on its equipment. GEA-897E covers thoroughly its line of air-cooled transformers; GEA-1662A is on the subject of trip-free air circuit breakers; GEA-1972 deals with Type FK-144A high-speed oil-tight circuit breaker; and GEA-2127 describes types LP-1 and LP-Y1 knife switches.

Bulletin No. 2198 of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, describes the "Shale Shaker," equipment for reclaiming and reconditioning rotary drilling mud. Copies are being sent upon request.

The International Harvester Company of America, 606 South Michigan Avenue, Chicago, Illinois, has issued five bulletins descriptive of McCormick-Deering power units, one of which is of the Diesel type. The circulars are all fully illustrated and, in addition to photographs, charts are included that show performance records. The bulletins are obtainable free upon request to the International Harvester Company.

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Alfred C. McAfee to Sales Staff Oil Center Tool Company

ALFRED C. McAFEE

Alfred C. McAfee, who has had a wide range of experience in the production division of the industry since 1918, when he served the Prairie Pipe Line Company at Ranger, Texas, has been appointed to the sales staff of Oil Center Tool Company, Houston, Texas. Educated at Texas A. & M. College and T. C. U., where he studied both geology and engineering, he has spent more than ten years getting a well-rounded out practical field education. He worked in the engineering department of The Texas Company in 1919, and later in that company's geological department. He roughnecked for Lofland Brothers, scouted for Tidewater Seaboard, and served in the production department of both Pure Oil Company and Stanolind Oil & Gas Company.

National Metal Congress and Exposition to Be Held in Chicago

Outstanding leaders in the metal world will take an active part in the technical program for the Seventeenth National Metal Congress and Exposition, to be held in Chicago the week of September 30.

This is indicated with the program for the five co-operating societies almost completed. The societies participating in this year's metal show are the American Society for Metals, the American Welding Society, the Wire Association, and the Institute of Metals Division and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers.

In the course of some 40 morning and afternoon sessions during the five-day period, more than 75 papers dealing with every phase of the metal industry, will be presented. More than 100 subjects will be discussed by men whose names are synonymous with the latest developments in the science and art of metals.

Headquarters for the Congress will be at the Palmer House, where morning sessions will be conducted. Afternoon sessions will be held at the New International Amphitheatre, where the Exposition will be located.

C. F. Whaley Visits MacClatchie Plant in California

C. F. Whaley, Mid-Continent manager for the MacClatchie Manufacturing Company, recently visited the MacClatchie plant at Compton, California. He spent his vacation attending to company business and seeing the sights in California. He was accompanied by Mrs. Whaley.

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